Resident Trout

Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*)

Rainbow Trout (*Oncorhynchus mykiss*)

Brown Trout (*Salmo trutta*)

Brook Trout (*Salvelinus fontinalis*)

Indicator Species Habitat

Resident trout species are used as indicator species for quality perennial streams and riparian vegetation (USDA 1986a, p.97). Resident populations reproduce and sustain themselves in the wild. Defined also as "resident trout" in the Carson Forest Plan, rainbow, brown and brook trout are non-native species that have been stocked extensively in northern New Mexico during the last 100 years. Rio Grande cutthroat trout is the only native of the resident trout management indicator species.

Rainbow trout was first introduced into the state in 1896 when it was stocked in Bluewater Creek (near Grants) and Eagle Creek (near Ruidoso). Since that time the rainbow trout has been introduced extensively into all major drainages of the state (Sublette et al. 1990). Rainbow trout prefer cool, clear lakes and cool, swift streams with rocky substrates and pool-to-riffle ratios approximately 1:1. Overhanging vegetation on banks, deep pools, submerged vegetation, log jams, boulders, etc. are in various combinations essential habitat components for escape and resting cover. Small streams should be shaded by up to 50 to 75 percent of canopy cover or have adequate undercut banks to reduce and stabilize water temperature. Deep, low velocity pools are important for overwintering. They tolerate a range of limnological conditions including temperature (0 – 28.3 C and pH (5.8 – 9.6). Adult rainbows avoid permanent residence in water temperatures above 18 C although lethal temperatures are considered 25 C.

Brown trout is native to Europe and western Asia. It was first introduced into the United States in 1883 and now occurs widely throughout much of the United States and Canada (Sublette et al. 1990). Brown trout was introduced into most major drainages of New Mexico during the early 1900s. Brown trout inhabit small to large coldwater streams and lakes. They tend to occupy deeper, lower velocity and warmer waters than other trout. A canopy shade of 50 to 75 percent is best to maintain habitat temperatures. Optimal temperatures for browns are 12 to 19 C. Lethal temperature for adults is about 27 C. Brown trout prey upon other species of trout and compete with them for food and living space. They are especially incompatible with native species of trout (i.e., Rio Grande cutthroat and Gila trout), requiring that the native species be segregated from the brown trout (Sublette et al. 1990).

Brook trout is native to eastern Canada and northeastern United States and has been introduced widely throughout much of the United States and Canada (Sublette et al. 1990). Brook trout was introduced into most major drainages of the New Mexico during the early 1900s. It is found primarily in cold, clear headwater streams, but also live in cold lakes. Brook trout adapt well to a variety of lentic and lotic environments. Distribution is primarily controlled by water temperature (Raleigh 1982). The preferred temperature is 13.9 – 15.6 C. The species does poorly in waters warmer than 20 C for extended time and lethal is about 25 C.

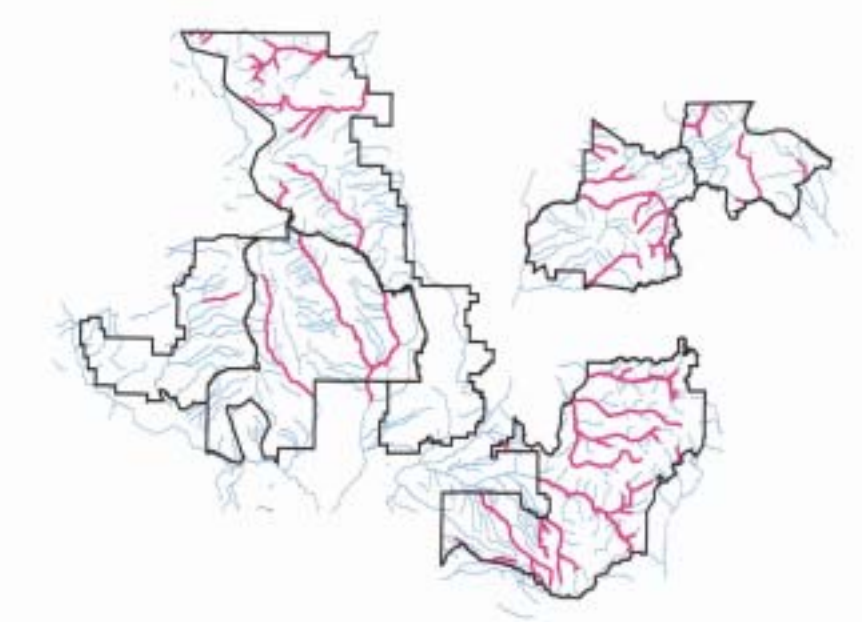
Rio Grande cutthroat trout (RGCT) represents the only extant native salmonid on the Carson National Forest. The historic range of the Rio Grande cutthroat is not definitely known although it likely encompassed all waters presently capable of supporting trout in the Rio Grande drainage,

including the Chama, Jemez and Rio San Jose drainages along with "trout" waters of the Pecos and Canadian drainages. Populations of this subspecies in New Mexico inhabit isolated headwaters of three major drainages. Of these, the Rio Grande drainage has the most populations with 23 in the Sangre de Cristo Mountains, 13 in the Jemez Mountains, four in the San Juan Mountains, and one in the Black Range (Sublette 1990).

RGCT prefer clear, cold streams with deep pools and consistent water flow and lakes. Population densities are regulated mostly by stream size and morphology (Koster 1957). Deeper pools provide overwintering habitat, and consistent flows are important. Stream productivity is a reflection of general water quality. Substrates with clean gravels of various sizes and with little embeddedness provide for macroinvertebrate production as a consistent food source. Clean gravel substrates are also important for successful cutthroat reproduction. Undercut banks and large woody debris anchored throughout the stream course provide summer cover for predator avoidance (Sublette et al. 1990). Preferred water temperatures for the RGCT are between 5 and 16.5 degrees Centigrade. Optimum habitat includes the absence of and protection from non-native trout species, such as brown, rainbow and brook trout.

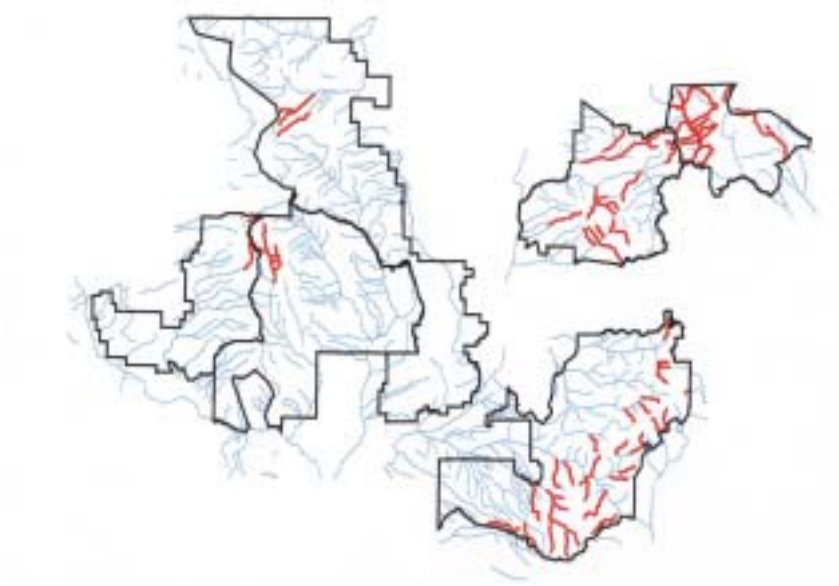
The distribution of the Rio Grande cutthroat trout has declined to nine percent of its former range in New Mexico (Duff 1996). Currently, the species is restricted primarily to headwater tributaries within its native range. As with many western native fish species, introduction of non-native fishes and habitat alterations are primarily responsible for its reduction in range and abundance (Stork 1975; Sublette et al. 1990; Behnke 1992). The USDA Forest Service considers the Rio Grande cutthroat trout a sensitive species, as well as, a management indicator species. The American Fisheries Society listed the subspecies as "protected" and of "special concern". In New Mexico it is treated as a sport species and is subject to State Game Commission fishing regulations.

Approximately 440 miles of perennial stream on the Carson National Forest are known habitat for resident trout (Forest Inventory 2002). Rainbow, brown or brook trout occupy about 50 percent (~225 miles) of that habitat (Map 1).



Map 1. Non-native Resident Trout and Rio Grande Cutthroat Trout Habitat Distribution on the Carson National Forest (Forest Inventory GIS Data 2002

Approximately 269 miles of perennial stream on the Carson National Forest are known habitat for the Rio Grande cutthroat trout (Map 2) and 190 miles is potential habitat (Forest inventory 2002). There are about 50 miles of stream where native and non-native occupancy overlaps.



Map 2. Rio Grande Cutthroat Trout Habitat Distribution on the Carson National Forest (Forest Inventory GIS Data 2002)

Management Activities or Natural Events That May Affect Habitat

Negative:

Rainbow, Brown and Brook Trout -- All non-native resident trout species are affected by whirling disease although not as severely as native trout. Angler pressure can be a factor. Removal of exotic species to benefit native species. Habitat degradation and alteration from activities such as road building, wildfire, grazing, recreation, irrigation. Changes in water quality parameters such as pH, temperature and turbidity that are not within the species range of tolerance.

Rio Grande Cutthroat Trout -- The introduction of exotic trout species, whirling disease and angler pressure. Habitat degradation and alteration from activities such as road building, wildfire, grazing, recreation, irrigation resulting in sedimentation, increased fluctuation in temperatures, less woody debris and unnatural hydrographs. Changes in water quality parameters such as low pH, high temperatures, and persistent sedimentation are detrimental to RGCT.

Competition with non-native species and habitat degradation have caused populations to primarily occupy headwater reaches. Construction of fish migration barriers on stream segments is used as a short-term solution to protect pure populations or enable restorations; however barriers will contribute to increased isolation and lack of genetic mixing.

Positive:

Rainbow, Brown and Brook Trout -- Improvement of riparian habitats and upland watershed improvements through grazing management, road closures, stream habitat improvements and best management practices.

Rio Grande Cutthroat Trout -- The development of a range-wide conservation assessment and strategy, as well as a management and operation plan in place. Fish barriers are viewed as a short-term protection, with the ultimate goal of protecting additional stream miles and drainages;

mechanical removal of non-native trout in mixed composition populations until a restoration treatment is feasible; restoration treatments and reintroduction within historic ranges; improvement of riparian habitats and upland watershed conditions through grazing management, road closures, addition and recruitment of woody debris and best management practices.

Plans, Regulations and Guidelines Supporting, Maintaining or Improving Habitat

- *Carson National Forest Land and Resource Management Plan, Forest-wide Wildlife and Fish* include standards and guidelines for Rio Grande cutthroat trout, as well as coldwater fisheries, fish passage, trout fisheries capacity and riparian vegetation (USDA 1986c, Wildlife & Fish Habitat).

  RIO GRANDE CUTTHROAT TROUT… Continue activities to improve Rio Grande Cutthroat habitat with the objective of securing the species. Develop Rio Grande Cutthroat trout fisheries within selected areas identified in conjunction with the New Mexico Department of Game and Fish (FP Wildlife & Fish Habitat – 4).

  RIPARIAN WOODY VEGETATION... On wet meadows and other riparian areas, favor the establishment of woody riparian vegetation as defined in FSH 2509.23. Control livestock and wildlife grazing through management and/or fencing to allow for adequate establishment of vegetation and the elimination of overuse (FP Wildlife & Fish Habitat – 12).

  EXOTIC SPECIES... Manage in cooperation with NMDG&F for indigenous fauna. Exotic species will not be introduced. Unapproved exotics which become established on National Forest System Lands will be managed toward the goal of elimination (FP Wildlife & Fish Habitat – 13).

  POPULATIONS... Cooperate with NMDG&F and other agencies to maintain wildlife and fish populations within identified habitat capabilities (FP Wildlife & Fish Habitat – 13).

  COLD WATER FISHERIES... Inventory, evaluate, and improve areas of streams, lakes, and wetlands for coldwater fish, especially the Rio Grande cutthroat trout (FP Wildlife & Fish Habitat – 13).

  FISH PASSAGE... Provide for fish passage under all roads crossing perennial streams (FP Wildlife & Fish Habitat – 13).

  TROUT FISHERIES CAPACITY... Increase carrying capacity for put-and-take wild trout fisheries through the installation of stream improvement structures, including the use of beaver to build and maintain beaver dams (FP Wildlife & Fish Habitat – 13).

  RIPARIAN VEGETATION... Inventory riparian vegetation conditions and manage to achieve acceptable riparian standards. Direct habitat improvements may include planting, seeding, fencing, and rejuvenation of woody vegetation through selective cutting and burning (FP Wildlife & Fish Habitat – 13).

  Standards and Guidelines for **Management Area 14--Riparian** include, "(m)anage for these indicator species: resident trout (cutthroat)…" (USDA 1986c, p. 4. Pine <40% - 1, 5. MC/PP >40% - 1, 7. Unsuitable - 1).

- *Record of Decision for Amendment of Forest Plans* (1996) provides guidelines relative to the management of both Mexican spotted owl and northern goshawk habitat. In Riparian Areas "(e)mphasize maintenance and restoration of healthy riparian ecosystems through conformance with forest plan riparian standards and guidelines. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented." (USDA 1996, p. 90)

- *Long Range Plan for the Management of the Rio Grande Cutthroat Trout in New Mexico* (2002) developed by the New Mexico Department of Game and Fish provides guidance to agencies, conservation groups and interested individuals on future management actions related to the Rio Grande cutthroat trout in New Mexico (NMDGF 2002).

- *Wild and Scenic Rivers Act* (1968) and *Amendment 12 of the Carson Forest Plan* (2002) give interim management of inventoried eligible rivers on the Carson National Forest. Pending a Wild and Scenic "suitability" determination or a recommendation for or against designation, protective management requirements (subject to valid existing rights and site-specific environmental analysis) ensure the eligible river segments on the Carson National Forest protection for their outstandingly remarkable values. In many cases the outstandingly remarkable value for which a river segment is eligible is the ability to support and maintain existing Rio Grande cutthroat populations.

- *Clean Water Act* (amended 1972 & 1987)

Habitat Condition And Trend On The Carson National Forest

Resident trout include all species of salmonids on the Carson, both native and non-native species. The Forest Plan EIS identifies 400 miles of occupied habitat (USDA 1986a, p. 97). The total number of stream miles has not changed since the EIS was prepared. However, the data processing and GIS abilities have resulted in a refinement of the actual habitat to approximately 444.26 miles.

Even though the trend in habitat is stable, monitoring aquatic habitat has also led to a much more precise breakdown of occupied habitats between Rio Grande cutthroat (Forest Service Sensitive) and other non-natives such as brook trout, brown trout and rainbow trout. The following table is a summary of both native and non-natives by stream miles by watershed on the Carson National Forest.

Table 1. Stream Miles for Native and Non-Native Trout Species on the Carson National Forest

Stream Name	Miles			
	Restoration Potential	RGCT Only	Non-Native Only	RGCT & Non-Native
Rio de los Piños (13010005050)[1]				
Rio de los Piños	3.25		3.35	
Lobo Creek	1.76		1.76	
Diablo Creek	2.58		2.58	
Escondido Creek	1.27		1.27	
Beaver Creek	4.79		4.79	
Cruces Creek	2.53		2.53	
Tanques creek		1.96		

[1] Watershed Hydrologic Unit Code

Stream Name	Miles			
	Restoration Potential	**RGCT Only**	**Non-Native Only**	**RGCT & Non-Native**
Rio Nutrias	3.87	2.49	3.87	0
Rio San Antonio	15.63		15.63	
Lagunitas Creek	5.2		5.2	
Canada Tio Grande	5.09	4.46	5.09	1.34
Total	**45.97**	**8.91**	**46.07**	**1.34**
El Rito Creek (13020102090)				
Canada Chacon		2.31		
Hachita Canyon		2.14		
Salvador Canyon		1.65		
Gurule Canyon		1.83		
El Rito Creek		8.23	4.48	
Total	**0**	**16.16**	**4.48**	**0**
Canjilon Creek (13020102060)				
Canjilon Creek		5.83		
Total	**0**	**5.83**	**0**	**0**
Rio Tusas/ Vallecitos (13020102080)				
Jaroso Creek		1.56		
Total	**0**	**1.56**	**0**	**0**
Rio Costilla (13020101010)				
La Cueva Canyon		2.27		
Comanche Creek		9.93		
Vidal Creek		5.03		
Chuck Wagon Creek		2.47		
Gold Creek		3.12		
La Belle Creek		2.79		
Grassy Creek		3.06		
Holman Creek		2.99		
Spring Wagon Creek		2.96		
Little Costilla Creek		4.74		
Powder House Creek		4.64		
Rio Costilla	5.17	5.17		5.17
Total	**5.17**	**49.17**	**0**	**5.17**
Vermejo (11080001010)				
Leandro Creek		2.5		

Stream Name	Miles			
	Restoration Potential	RGCT Only	Non-Native Only	RGCT & Non-Native
Total	**0**	**2.5**	**0**	**0**
Ponil (11080002010)				
North Ponil Creek	3.4	2.67	0.89	3.4
McCrystal Creel		4.79		
Total	**3.4**	**7.46**	**0**	**0**
Red River (13020101040)				
Bitter Creek		4.64		
Jiron Creek		2		
Cabresto Creek	7.75	7.9	8.9	5.34
Lake Fork Creek	2.56	2.83	2.35	1.71
Deer Creek		1.19		
Place Fork Creek		3.56		
Willow Fork Creek		1.97		
Columbine Creek		4.99		
West Fork Creek	1.74		1.74	
Middle Fork Creek	1.27		1.27	
Sawmill Creek	1.17		1.17	
East Fork Creek	2.68		2.68	
Red River	18.28		18.28	
Pioneer Creek		5.01	5.01	
Total	**35.45**	**34.09**	**41.4**	**7.05**
Rio Hondo (13020101050)				
San Cristobal Creek		5.18		
Yerba Canyon		2.91		
Manzanita Canyon		2.61		
Italianos Canyon		2.25		
Gavilan Canyon		1.96		
South Fork Rio Hondo		4.4		
Rio Hondo	9.74	3.65	6.54	3.65
Total	**9.74**	**22.96**	**6.54**	**3.65**
Rio Grande del Rancho (13020101060)				
Rio Fernando		3.18	1.93	
Valle Largo		0.67	0.88	0.76
Osha Pass		0.86	1.09	1.11

Stream Name	Miles			
	Restoration Potential	**RGCT Only**	**Non-Native Only**	**RGCT & Non-Native**
Tienditas Creek		2.84	1.86	1.03
Rio Chiquito	15.6		15.6	
Palociento Creek		2.46		
Frijoles Creek	1.52	0.7	1.52	1.36
Rito de la Olla	11.93	2.1	11.25	0.68
Rio Grande del Rancho	11.81		11.81	
Jarosa Canyon		1.55		
Saloz Canyon		1.36		
Totals	**40.86**	**15.72**	**45.94**	**4.94**
Rio Pueblo (13020101070)				
Sardinas Canyon	1.37	1.75	0.54	1
Rito La Pressa	2.96	2.49	1.27	1.5
Policarpio Canyon		2.25	0.21	0
Arellano Canyon	1.54		1.54	
La Junta Canyon	5.36		5.36	
Duran Creek	1.74	1.26	0	1.48
La Cueva Canyon		3.21		
Osha Canyon		4.6		
Comales Canyon		3.65		
Cordova Canyon		1.81		
Agua Piedra Creek	0.81	2.88	0	0.81
Rito Angostura		5.66		
Alamito Creek	4.62	4.62	4.62	0
Raton Canyon	1.46		1.46	
Rio Pueblo	5.46		5.46	
Indian Canyon		1.7		
Jicarita Creek		2.26		
East Fork Rio Santa Barbara	0.41	2.45	0	0.41
Middle Fork Rio Santa Barbara	3.62	3.13	0	3.62
West Fork Rio Santa Barbara	4.31	0.86	0	4.31
Rio Santa Barbara	5.37	0	1.09	4.03
Rio Chiquito	5.84		5.84	
Rio San Leonardo		3.54	3.54	
Total	**44.87**	**48.12**	**30.93**	**17.16**

Stream Name	Miles			
	Restoration Potential	RGCT Only	Non-Native Only	RGCT & Non-Native
Sabastian Martin (13020101090)				
La Jara Canyon		1.68	0	3.52
Rio De Truchas		1.53	0	3.69
Total	**0**	**3.21**	**0**	**7.21**
Upper Mora (11080004010)				
West Fork Luna Creek		2.29		
East Fork Luna Creek	2.76	0.74	0	2.76
Total	**2.76**	**3.03**	**0**	**2.76**
Coyote (11080004020)				
Jarosa Creek		0.9		
Total	**0**	**0.9**	**0**	**0**
Grand Total	***188.22***	***219.62***	***175.36***	***49.28***

Note: The first column or "Restoration Potential" is contained in the other column numbers: 219.62 + 175.36 + 49.28 = 444.26 miles.

Rainbow, Brown and Brook Trout

The resident non-native trout tend to have a wider range of tolerance for habitat conditions than native trout species. Sedimentation of the substrate reducing spawning habitat can result from various activities such as roading, grazing, fire, etc. Habitat quality is also influenced by grazing and dewatering. Overall, most areas of the Forest that are occupied by resident trout and may be supplemented by stocking appear to be in good or stable condition. Stream habitat surveys are currently ongoing to make a qualified determination of overall conditions and trend.

Rio Grande Cutthroat Trout

Rio Grande cutthroat habitat condition has significantly decreased as a result of early non-native trout stocking efforts throughout the western United States in the late 1800's. On the Carson National Forest, pure populations of RGCT are mostly limited to the upper reaches of streams that have either man-made or natural barriers (waterfalls or beaver dams) that prevent non-native trout from upward migration and accessing the system.

Habitat destruction and degradation have impacted most streams occupied by Rio Grande cutthroat trout. Rio Grande cutthroat habitat has been degraded by many activities. Road systems are the primary source of sedimentation in streams on the Forest. Although affected streams may still be suitable, they are less than optimal cutthroat habitat. Other factors that reduce habitat quality include domestic livestock grazing, which can destroy overhanging banks and increase sedimentation, and diversions of water for irrigation, which can significantly reduce the amount of water in a stream system. Mining has impacted specific sites. Dewatering and sedimentation are the two most prevalent factors affecting habitat conditions (Duff 1996).

Timber harvest and associated road building have led to the deterioration of RGCT habitat; however timber harvest on National Forests has declined appreciably in the last 16 years. From 1986 to 1990 the Carson National Forest averaged 25.5 million board feet (MMBF) per year of timber cutting. From 1991 to 2001 the average was 7.1 million board feet – a decline of 72

percent in volume. Few new roads are built in conjunction with timber harvest, since the existing infrastructure can be used. Any new road construction is usually for moving an existing portion of road out of a sensitive area, such as riparian vegetation along stream banks. Roads are being decommissioned and obliterated each year, reducing their contribution to sedimentation of streams. In the 1990's the Carson National Forest decommissioned on 70 to 100 miles of road per year. Since 2000, the Forest has decommissioned an average of 50 miles per year. Many of the current pure, stable, and secure populations occur at elevations where timber harvest has not occurred and therefore, have not been affected.

Livestock grazing practices on public land in New Mexico have significantly improved over the last century. Changing livestock stocking levels and improved management practices have occurred and will continue to occur following current management direction. Restoration of riparian areas and maintaining healthy habitat is a priority for the Carson National Forest, as well as the Southwestern Region (USDI 2002, NMDGF 2002).

NM Department of Game and Fish and Forest Service biologists have assessed habitat condition in streams with pure, stable and secure populations (NMGF 2002). Condition was rated using the following classification:

0	no habitat problems
0-1	headwater reaches are in good condition & lower reaches have problems in discrete areas
1	some problems identified (sedimentation, lack of pools, warm water temperature, heavy metals, etc.)
2	pervasive problems related to RGCT habitat identified

In most instances, sedimentation and problems related to livestock grazing were identified as primary sources of habitat degradation. While streams that are rated with a "1" have some level of habitat degradation that probably prevents populations from reaching maximum reproductive capability, the degradation is not judged to be a threat to the existence of any of the populations (USDI 2002). In most instances, stream habitat condition was rated between the range of 0 to 1, with very few streams rated as 2. Based on the outcome of these assessments for each stream, it is the opinion of the Forest Service and NMDGF that habitat problems are typically localized and can be or are being addressed through management practices.

Some population distributions and numbers are likely limited by sedimentation, stream temperature, low pH and lack of quality pools. Other population distributions, genetic purity and numbers appear limited by competition and predation from and hybridization with non-native species. Recent removal and restoration efforts have protected and improved populations although there is still an overall decline in occupancy in historic ranges. Although recovery of these habitats can be slow, the continued commitment to manage and restore watersheds will improve RGCT habitat over time. Physical habitat conditions and **habitat trend for resident trout is stable**.

As management activities on the Carson National Forest proceed to expand populations to lower elevations, restoration will continue to improve habitat condition in those areas. For example, a *Watershed Restoration Action Strategy for the Comanche Creek Watershed* on the Questa Ranger District has been written, and a work plan has been submitted and approved by the New Mexico Environment Department. Six partners will work together to improve habitat conditions on Comanche Creek, a watershed with over 70 km of streams and pure RGCT in the upper

tributaries. Recovery of this watershed will be a substantial gain for RGCT, especially if the pure populations expand downstream.

Fish Barriers

Barriers are essential to separate RGCT from non-native salmonids. However, to be effective barriers must be checked frequently and be maintained. Flood events can blow a man-made barrier out, change the channel morphology permanently, or provide a temporary channel around the barrier that fish can use for upstream migration. Older gabion barriers (rocks in a wire basket) and culverts appear to be the most vulnerable structures. Changes in water velocity (either an increase or decrease depending on the situation) can change an impassable barrier into one that can be passed. These structures should be checked on a regular basis.

Regardless of the structure, reaches above barriers need to be checked regularly because non-natives are sometimes found upstream of barriers with no evidence of impairment to the barrier. This can be caused by an incomplete removal of non-natives during stream restoration or illegal transplantation of non-native trout. The only solution to the latter situation is the education of the public and gaining their widespread support for RGCT.

The Forest Service assesses barriers as part of its stream surveys. With the increase in numbers of Forest Service fisheries biologists and technicians that has occurred in the last few years, miles of stream inventory have increased. On the Carson National Forest, besides one Supervisory Fisheries Biologist, another full time Fisheries Biologist and two summer technicians have been added to the staff. They completed approximately 50 miles of stream surveys in 2001 and 60 miles in 2002. For these reasons, the US Fish and Wildlife Service has determined that barrier failure is not a threat to pure, stable and secure populations (USDI 2002).

Population Trend And Viability

Rainbow, Brown and Brook Trout

The rainbow trout is the most widely cultured and stocked trout in North America and occurs across the majority of the United States and Canada. The rainbow and, to a lesser degree, the brown trout have been stocked historically and are currently stocked in northern New Mexico. The occurrence of whirling disease in hatcheries has significantly reduced the current stocking levels. A number of stocked fish do survive in the stream habitats to become resident trout. Hybridization and competition from natives are not significant factors with these species since over time they will out compete and dominate the native species. Restoration activities for natives have been relatively small in scale, but could become a factor on non-native populations as the extent of restorations increase.

The NatureServe database (www.natureserve.org/explorer) documents that throughout its range, rainbow trout is listed as “G5”, (i.e., globally secure and common, widespread and abundant). Reasons given for the G5 ranking are its large range and that it is common in many areas and there is no evidence of large-scale declines. It is not vulnerable in most of its range. Species with this rank typically occur in more than 100 localities, and there are more than 10,000 individuals. Within the United States, the rainbow trout is listed as “N5” (i.e., secure and common, widespread and abundant). In New Mexico, the rainbow trout is listed as “SE” (i.e., apparently secure - exotic in the state/province).

The brown trout is an exotic species that now occurs in 46 of the lower 48 states being absent in several states in the extreme south and is also has a global rank of “G5” and a state rank “SE”.

The brook trout is an uncommon in New Mexico and is an exotic in the western United States. It is native to the eastern United States and Canada and is ranked "G5". It also has a state rank of "SE".

Rio Grande Cutthroat Trout

The Rio Grande cutthroat trout evolved in areas where it was the only trout species present. It was once widespread in the upper Rio Grande and Canadian river basins of northern New Mexico and south-central Colorado (Sublette et al. 1990). The historic range of RGCT has been greatly reduced over the last 150 years (USDI 2002). As more people migrated into New Mexico, the RGCT was over-harvested. In response to the RGCTs decline, various non-native trout species were stocked in the state's rivers, lakes and streams. Since the late 1800's, non-native trout have been introduced throughout most of the Rio Grande cutthroat's native range. Generally, the introduced trout species will out-compete the native cutthroat for food and space (Sublette et al. 1990). Rio Grande cutthroat also readily hybridize with other spring spawning trout, such as rainbow trout (*Oncorhynchus mykiss*), and subspecies of cutthroat trout (*O. clarki*), contaminating the genetics of pure RGCT populations (Sublette et al. 1990; NMDGF 1999). Many populations have been lost or impacted by water diversions, dams, habitat degradation, changes in hydrology, hybridization with rainbow trout, or competition with brown or brook trout.

The NatureServe database (www.natureserve.org/explorer) documents that throughout its range, the Rio Grande cutthroat trout is listed as "G4", which means it is uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently the species is not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals exist in its range. The RGCT is ranked "T3". Reasons given for this ranking are its small range in the Rio Grande drainage of Colorado and New Mexico; approximately 200 extant populations; favorable protection and management in place; secure and likely to improve in status with active management. **Given the nature of stocking programs on the Carson National Forest, the population trend for the combination of resident trout species is stable.** Although population surveys have been done and are continuing, stocking programs can over shadow apparent trend data in areas where stocking is conducted. As survey data is accumulated from other areas, trend data can be more accurately estimated for native trout.

Most of the following information in this section comes from the "Finding" published by the US Fish and Wildlife Service in the Federal Register in June 11, 2002 (USDI 2002).

Habitat Loss

Quantifying the exact magnitude of loss in either number of fish or habitat is difficult because there are no baseline data (USDI 2002). Stumpff and Cooper (1996) estimated the loss in habitat (stream miles) to be about 91 percent in New Mexico. Harig and Fausch (1998) suggest that native cutthroat (greenback and RGCT) have been reduced to less than one percent of their historic habitat. Because RGCT are now restricted to headwater and first and second order streams that are narrow and small compared to larger second, third, and fourth order streams they once occupied, the absolute loss of habitat is greater than stream miles might indicate and includes the loss of diversity of habitat found in larger stream systems. As a consequence of the habitat loss, RGCT populations that were once connected are now fragmented. Habitat fragmentation, however, is a threat that can be alleviated by management activities.

Currently, 106 populations of Rio Grande cutthroat trout are estimated in New Mexico (NMDGF 2002) and 161 in Colorado (Alves et al. 2002)[2] in both streams and lakes (USDI 2002). All of these populations contribute in some way to the overall security of the range-wide population. Still, many of these populations are hybrids, some populations have an extremely low number of individuals, and some have been invaded by non-native salmonids that either hybridize or compete with RGCT (USDI 2002). These factors can make individual RGCT populations more vulnerable to extinction and limit the likelihood of their long-term persistence. Conservation actions can remove or reduce these threats.

Population Size

For the long-term persistence of a population, sufficient population size is needed to prevent inbreeding depression (genetic defects caused by mating of closely related family members) and maintain genetic variation (Franklin 1980). Large populations also have been suggested to be less susceptible to both demographic events (random changes in the population structure, e.g., uneven male/female ratios), and environmental random events (random changes in the fishes' surroundings) that can eliminate small populations. The expected time to extinction decreases as population size decreases (Rieman et al. 1993). Habitat size (length of stream) and habitat quality affect the potential size of the population: the larger the fragment, the more likely the population will be large and able to resist chance extinctions (Gilpin and Sould 1986). Smaller stream fragments can have less diverse habitats and a lack of refugia (areas where individuals can survive through environmentally challenging periods) that can lead to greater population fluctuations through time (Rieman and McIntyre 1995). As long as birth rate equals or exceeds death rate, small populations may persist; however, smaller isolated populations may be more vulnerable to detrimental effects of genetic change and detrimental effects of demographic and environmental change.

Non-native Salmonids

A population of RGCT is not considered secure if non-native salmonids are present. The presence of rainbow trout in RGCT populations is unacceptable because of hybridization. Because brook trout and brown trout are fall spawners (RGCT spawn in spring), they do not hybridize with RGCT. However, they are competitors for food and space, and there have been both historic and recent examples of population extirpation due to non-native introductions. In some limited situations, co-existence of RGCT and brook or brown trout may occur, especially in high-gradient or high-elevation streams that may favor cutthroat trout. Though, not enough is known about the competitive interactions between these fish, to know what factors tip the scale in favor of the non-natives over RGCT.

Inextricably linked to the presence of non-natives is the presence of a barrier. Barriers prevent non-natives from migrating into habitat occupied by RGCT. They also prevent the upstream migration of RGCT, limiting gene flow among populations. Until more watersheds with connecting tributaries are restored, having secure barriers to prevent invasion of non-natives is essential for protecting existing populations. Once large watersheds are restored, upstream barriers could be breached to allow for free passage of RGCT upstream and downstream.

In the USFWS status review (USDI 2002), populations had to be protected by a barrier to be considered secure with no non-native trout above the barrier. Thirteen populations were

[2] This reference, as well as some others underlined, are not listed in "References" at the end of this document. They were taken from the Review for Rio Grande cutthroat trout. Federal Register Federal Register 67(112) 39936-39947. 11 June 2002.

identified as pure (confirmed by appropriate genetic testing), have over 2,500 fish, are secured by a barrier, and do not coexist with non-natives. Table 2 displays streams with pure, stable and secure populations of Rio Grande cutthroat trout on the Carson National Forest.

Table 2. Pure & Stable RGCT Populations on Carson NF

Stream	Ranger District
El Rito Creek	El Rito
Bitter Creek	Questa
Columbine Creek	Questa
San Cristobal Creek	Questa
Powderhouse Creek	Questa
Policarpio Creek	Camino Real

Currently, Forest Service and NM Game and Fish personnel remove non-natives from the streams that have pure, stable and secure populations on the Carson National Forest, during population surveys and as part of ongoing management actions. The FWS has determined that fragmentation is not a threat to the persistence of these populations now or in the foreseeable future (USDI 2002). All of the pure, stable and secure populations have over 2,500 fish, which provide sufficient numbers to prevent an unacceptable rate of inbreeding and to maintain genetic variability in these populations. Recognizing this, population sizes between 2,000 and 5,000 have been suggested as appropriate for the long-term persistence of other fish populations (Nelson and Sould 1987, Reiman and McIntyre 1993, Hilderbrand and Kershner 2000), based on both genetic and demographic consideration. Additionally, the length of these streams (mean equals 12.4 km (7.7 mi)) is sufficient to provide diverse habitats to meet all the life history requirements of the fish. High fish density (mean equals 0.5 fish/m (0.15 fish/ft)) present in these core streams supports this statement (USDI 2002).

Catastrophic Events

Another potential threat to the RGCT is related to catastrophic events. Wildfires are a natural disturbance in forested watersheds. Historically, fires occurred every 4-5 years (Swetman 1990), and burned the understory leaving open stands of older trees. Fire suppression has resulted in large increases in fuel loads and understory density. As a result, under the proper conditions, wildfires today can spread rapidly and burn intensely.

In the Southwest, the fire season (May to June) is followed by the monsoon season (July to August). Consequently, denuded watersheds can be hit by heavy precipitation leading to floods and ash flows in streams. Because fire is unpredictable, it is hard to assess how great the risk of fire is to individual RGCT populations. Because several trout populations in New Mexico have been impacted in the last 10 years by fire, it is logical to assume that a few isolated RGCT populations could be lost to the effects of fire in the foreseeable future.

Drought can affect existing populations of cutthroat trout as well. Water is becoming scarce in some reaches on the Carson National Forest, as streams experience nearly five years of drought.

Catastrophic fire can also provide the opportunity to reclaim streams that were invaded by non-natives. This situation has occurred on the Santa Fe National Forest where the Viveash Fire eliminated fish populations from the Cow Creek watershed in 2000. Once the habitat recovers, approximately 25 stream miles will be repatriated with RGCT. The Dome Fire in the Jemez Mountains extirpated the fish residing in Capulin Canyon. In partnership with Bandalier National Monument, the Santa Fe National Forest is developing plans to repatriate RGCT in approximately 10 miles of perennial stream.

Fire risk can be reduced through fuels reduction and prescribed burns. The Carson National Forest has an active program to improve forest health. Over the next 10 to 20 years it is possible that a small number of RGCT populations will be lost to fire; however, the USFWS does not believe that such a loss will affect the long-term persistence of the RGCT because the populations are widely distributed and loss of RGCT populations that contain non-natives provides an opportunity to reestablish pure RGCT populations (USDI 2002).

The US Fish and Wildlife Service cannot determine if fire is a threat to the 13 pure, stable, and secure populations (USDI 2002). Fire is unpredictable and there is no way of determining where or with what intensity a fire may burn because so many variables are involved. New Mexico is in the midst of a drought and fire can be a threat. Because the populations are spread out across the landscape and are not grouped together, the chances of more than one population being affected are reduced. As mentioned above, if catastrophic fire does occur, it provides an opportunity to reintroduce pure RGCT trout into streams that had been dominated by non-native trout and expand the range of RGCT. If a catastrophic event (e.g., fire, drought) results in the extirpation of one or more of these populations, the State and Forest Service would have the capability to replace the population with hatchery fish or fish transplanted from another pure population (USDI 2002).

Overutilization

There is no commercial fishing for RGCT. Because of fishing regulations in New Mexico, recreational angling is not considered a threat to the species. Many of the streams with RGCT are “catch and release" and those that are not have a two fish limit. Many of the streams with pure populations of RGCT are remote and angling pressure is light. Overutilization for scientific purposes is not considered a threat to RGCT. Because of advancements in molecular technology, a small clipping from a fin provides sufficient material to perform molecular analysis of genetic purity. To test for whirling disease, usually 60 fish are collected and these fish must be sacrificed. To minimize the collection of RGCT, non-native salmonids are collected preferentially over RGCT or sample sites are selected below a barrier that protects a population of RGCT. The US Fish and Wildlife Service has determined that overutilization for recreational and scientific purposes is not a threat to the pure, stable, and secure populations for the reasons stated above (USDI 2002). Overutilization for commercial or educational reasons has not been identified as a threat.

Whirling Disease

Whirling disease (WD) was first detected in Pennsylvania in 1956, being transmitted here from fish brought from Europe (Thompson et al. 1995). *Myxobolus cerebralis* is a parasite that penetrates through the skin or digestive tract of young fish and migrates to the spinal cartilage where it multiplies very rapidly, putting pressure on the organ of equilibrium. This causes the fish to swim erratically (whirl), and have difficulty feeding and avoiding predators. In severe infections, the disease can cause high rates of mortality in young-of-the-year fish. Water temperature, fish species and age, and dose of exposure are critical factors influencing whether infection will occur and its severity (Hedrick et al. 1999). It is likely that the parasite will continue to spread to more and more streams because animals and humans easily transport the spores.

Salmonids native to the United States did not evolve with WD. Consequently, most native species have little or no natural resistance. Colorado River cutthroat trout and rainbow trout are very susceptible to the disease with 85 percent mortality within 4 months of exposure to ambient levels of infectivity in the Colorado River. Percent survival of RGCT in this research was less

than one percent (Thompson et al. 1999). Whirling disease was first detected in New Mexico in 1988 in rainbow trout imported into private ponds in the Moreno Valley in northern New Mexico. The parasite has been confirmed in three drainages that support RGCT: South Fork Rio Grande, Rio Grande and Conejos. In New Mexico all WD positive fish are destroyed.

Although WD is a potential threat to RGCT, high infection rates will likely only occur where aquatic habitats are degraded, particularly in areas with high sedimentation, warm water temperatures and low dissolved oxygen. In clear coldwater streams, as is typical of RGCT habitat, it is present but seldom abundant. The USFWS has determined that WD is not a threat to the 13 pure, stable, and secure populations because these populations are located in high-elevation, headwater streams that typically have cold water and low levels of sedimentation. Although RGCT is susceptible to infection there has not been a documented loss or decline in population number due to WD in a wild RGCT population.

Current Regulatory Mechanisms and Public Sentiment

New Mexico has an approved *Long Range Plan for the Management of Rio Grande Cutthroat in New Mexico* currently being implemented that will "facilitate long range cooperative, interagency conservation of Rio Grande cutthroat trout." (NMDGF 2002) From 1999 to 2001, population inventory was completed on 18 streams, barrier evaluations were completed on 14 streams, and genetic samples were taken from fish in 17 streams. The plan has schedules for fiscal years 2003 to 2005 for population inventory and monitoring, collection and analysis of genetic material, assessing barriers, habitat inventory, inventory of unexplored streams, testing for and mapping WD, and maintaining a database of all the information. Based on this information, the USFWS has determined that the Forest Service has adequate regulatory mechanisms to protect and enhance RGCT populations and habitat.

Several stream renovation projects are planned in the upcoming years. One obstacle that must be recognized is public resistance to the use of piscicides such as antimycin. Antimycin is an antibiotic that is an effective fish toxicant. It can be neutralized at stations outside the treatment area. The public must be informed and support range expansion of RGCT, or restoration efforts could be undermined. The Carson and Rio Grande National Forests sponsor activities (e.g., Fish Fiesta) to educate and raise public awareness about RGCT. Public support is essential for the success of future projects, and the New Mexico recognizes the importance of education and outreach in achieving its conservation goals for the RGCT.

Carson National Forest

The Carson National Forest is cooperating with the New Mexico Department of Game and Fish (NMDGF) to restore and protect cutthroat populations (NMDGF 1999). There are approximately 57 tributaries on the Carson National Forest that contain RGCT populations. These streams are systematically being checked for purity of genetics. Approximately 30 streams or tributaries have Class A or B populations – the highest ratings for genetic purity. Although several pure populations of RGCT do have brown or brook trout coexisting in the same reach, the brown or brook trout will generally out-compete the cutthroat and eventually eliminate a cutthroat population in a stream system. A number of the streams or tributaries with suitable barriers have had the non-natives removed. During the past several years approximately 15 miles of RGCT streams have been restored or improved by removal of non-native species and either construction or improvement migration barriers. In addition, barriers were constructed in the past on streams with mixed populations of native and non-native species. These native populations are currently being maintained by mechanically removing the non-natives from above the barrier locations. This is necessary to maintain populations until a complete restoration is done.

Table 3. Streams Actively Managed for RGCT on Carson NF

Stream	Ranger District
East Fork Santa Barbara	Camino Real
Middle Fork Santa Barbara	Camino Real
Jicarita Creek	Camino Real
West Fork Luna Creek	Camino Real
Frijoles Creek	Camino Real
Policarpio Creek	Camino Real
Upper Rito La Pressa	Camino Real
Comanche Creek	Questa
Powderhouse Canyon	Questa
Leandro Creek	Questa
Middle Ponil Creek	Questa
El Rito Creek	El Rito
Canada Tio Grande	Tres Piedras
Tanques Canyon	Tres Piedras

Bag limits of RGCT have also been reduced over the last decade and many anglers are now practicing catch and release. They are also encouraged via trout clubs and other anglers to release cutthroats and keep the non-natives caught in RGCT waters.

Most occupied habitat is in upper stream reaches, which generally have less impact from management activities. However, these streams are smaller in size and flow, resulting in a smaller area of habitat. Historic habitat in lower stream reaches is more impacted. Since implementation of the Forest Plan forest-wide road closure activities and increased focus on riparian management, many areas appear to be stabilizing.

Conclusions

The US Fish and Wildlife Service determined during status review that "candidate" status was not warranted. As stated in the Federal Register Finding dated June 11, 2002, **"(t)he Service has determined that there are sufficient, genetically pure, secure, and stable populations of Rio Grande cutthroat trout distributed throughout its historical range to preclude it from becoming a candidate at this time"** (USDI 2002).

There are 13 confirmed pure populations (6 on the Carson NF) of RGCT with populations over 2,500 fish, that are secured by barriers and do not have non-native competitors (Table 2). Specific threats discussed in detail above do not indicate that the 13 core populations are threatened by any of the identified threats alone or in combination (USDI 2002). The USFWS finds that these populations are likely to persist into the future because of the large numbers of individuals within these populations and the threats are adequately addressed by the ongoing management actions of State and Federal agencies to remove non-natives (brook and brown trout), test for genetic purity, conduct stream surveys, maintain barriers, conduct public education and outreach, and test for WD. **Rio Grande cutthroat trout populations on the Carson National Forest are considered stable.**

References

Alabaster, J. S.; Lloyd, R. 1980. Water quality criteria for freshwater fish. London England: Butterworths. 297 p.

Alves, J. 1998. Status of Rio Grande cutthroat trout in Colorado. Denver, CO: Division of Wildlife. 10 p.

Alves et al. 2002.[3]

Behnke, R.J. 1992. Native trout of western North America. Monograph 6. Bethesda, MD: American Fisheries Society.

Duff, Donald A., tech ed. 1996. Conservation assessment for inland cutthroat trout: distribution, status and habitat management implications. General Technical Report RM-GTR-256. Ogden, UT: US Department of Agriculture, Forest Service, Intermountain Region. 120 p.

Franklin, I.R. 1980. Evolutionary change in small populations. pp. 125-150, in: M.E. Soule and B.A. Wilcox (eds.), Conservation biology: an evolutionary ecological perspective. Sunderland, MA: Sinauer Associates.

Gilpin and Sould. 1986.

Harig, A.L.; Fausch, K.D. 1999. Minimum habitat requirements for establishing translocated cutthroat trout populations. Annual Progress Report to Colorado Division of Wildlife, US Forest Service and Trout unlimited.

Hedrick et al. 1999.

Hilderbrand and Kershner. 2000.

Koster, William J. 1957. Guide to fishes of New Mexico. Albuquerque, NM: University of New Mexico Press in Cooperation with New Mexico Department of Game and Fish: 29-30.

Meehan and Platts 1978

NatureServe Explorer: An online encyclopedia of life [web application]. 2001. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: http://www.natureserve.org/explorer. (Accessed: March 23, 2002).

Nelson and Sould 1987.

New Mexico Department of Game and Fish. 2001. BISON-M (Biota Information System of New Mexico): Biological database for New Mexico. NMDGF in cooperation with USDI BLM, USDI FWS, USDI Bureau of Reclamation, US Army Corps of Engineers, USDA Forest Service and University of New Mexico. http://nmnhp.unm.edu/bisonm

New Mexico Department of Game and Fish. 1999.

New Mexico Department of Game and Fish. 2001. Draft Conservation Agreement for the Range-wide preservation and management of the Rio Grande cutthroat trout. New Mexico Department of Game and Fish, Colorado Division of Wildlife, USDA Forest Service, USDI Bureau of Land Management, USDI National Park Service.

New Mexico Department of Game and Fish. 2002. Long range plan for the management of the Rio Grande cutthroat trout in New Mexico. Santa Fe, NM: New Mexico Department of Game and Fish.

Raleigh, R.F. 1982. Habitat suitability index: Brook trout. FUS/OBS-82/10.24. USDI, Fish and Wildlife Service. 42 p.

Reiman and McIntyre 1993.

[3] This reference, as well as some others are not fully described. They were taken from the Review for Rio Grande cutthroat trout. Federal Register Federal Register 67(112) 39936-39947. 11 June 2002.

Rinne, John N. 1995. Rio Grande cutthroat trout. In: Conservation assessment for inland cutthroat trout. Young, Michael K. (tech. ed.). General Technical Report RM-GTR-256. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 24-27.

Scott, W.B.; Crossman, E.J. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184. Ottawa, Canada: 966 p.

Storch, Donna. 1996, March. Biologist. USDA Forest Service, Carson National Forest, NM.

Stork, E.F. 1975. Distribution of Rio Grande cutthroat trout on the Santa Fe National Forest. MS Thesis. Fort Collins, CO: Colorado State University.

Stumpff, W. K. 1998. Rio Grande cutthroat trout management. Final Report. Federal Aid Grant F-60-M. Project No. 11. 14 p.

Stumpff, W.K.; Cooper, J. 1996. Rio Grande cutthroat trout Oncorhynchus clarki virginalis, on the Santa Fe National Forest. Boulder, CO: Western Interstate Commission for Higher Education.

Sublette, James; Hatch, Michael D.; Sublette, Mary. 1990. The fishes of New Mexico. Albuquerque, NM: University of New Mexico Press. 393 p.

Swetnam, T.W. 1990. Fire history and climate in the southwestern United States. Krammes, J.S., tech. coord. Proceedings of the symposium, Effects of fire management of Southwestern natural resources; 1988 November 15-1; Tucson, AZ. General Technical Report RM-191. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station: 6-17.

Thompson et al. 1995.

Thompson et al. 1999.

USDA Forest Service. 2000. Forest Service land and resource management and cutthroat trout conservation Part I: A summary of current forest land and resource management plan (LRMP) direction related to cutthroat trout conservation. Forest Service Report. US Department of Agriculture, Forest Service, Regions 1-6.

USDA Forest Service. 1986a. Environmental impact statement, Carson forest plan. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region. 386 p.

USDA Forest Service. 1986b. Record of decision for the Carson National Forest land and resource management plan. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region. 6 p.

USDA Forest Service. 1986c. Carson National Forest land and resource management plan. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region.

USDA Forest Service. 1987. Terrestrial ecosystems survey of the Carson National Forest. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region. 552 p.

USDI Fish and Wildlife Service. May 1980. Biological inventory Zuni project McKinley County, New Mexico. 105 p.

USDA Forest Service. 1996. Record of decision for amendment of forest plans – Arizona and New Mexico. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region. 96 p.

USDI Fish and Wildlife Service. 14 September 1998. 90-day finding for a petition to list the Rio Grande cutthroat trout. Federal Register 63(177): 49062-49063.

USDI Fish and Wildlife Service. 11 June 2002. Review for Rio Grande cutthroat trout. Federal Register 67(112): 39936-39947.