

Resident Trout

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 are the rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salvelinus fontinalis*), brook trout (*Salmo trutta*), and Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). Rio Grande cutthroat trout (RGCT) is the only native species with the other species being non-natives that have been stocked extensively in northern New Mexico over the past 100 years.

Rainbow trout was first introduced into New Mexico in 1896. 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 a pool-to-riffle ratio of approximately 1:1. Overhanging vegetation on banks, deep pools, submerged vegetation, log jams, boulders, etc., in various combinations, are essential habitat components for escape and resting cover. This trout species prefers small streams to 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. Rainbow trout tolerates a range of fresh water conditions, including temperature from 0 – 28.3 centigrade (C) and pH from 5.8 – 9.6. Adult rainbows avoid permanent residence in water temperatures above 18 C, with lethal temperatures around 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). It was introduced into most major drainages of New Mexico during the early 1900s. Brown trout inhabits small to large coldwater streams and lakes. The species tends 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 brown trout are 12 to 19 C. Lethal temperature for adults is about 27 C. Brown trout preys upon other species of trout and competes with them for food and living space.

Brook trout is native to eastern Canada and northeastern United States and has been introduced widely throughout much North America (Sublette et al. 1990). Brook trout was introduced into most major drainages of New Mexico during the early 1900s. Brook trout adapts well to a variety of stream and lake environments. It is found primarily in cold, clear headwater streams, but also lives in cold lakes. Distribution is mainly 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 an extended time and 25 C is considered lethal.

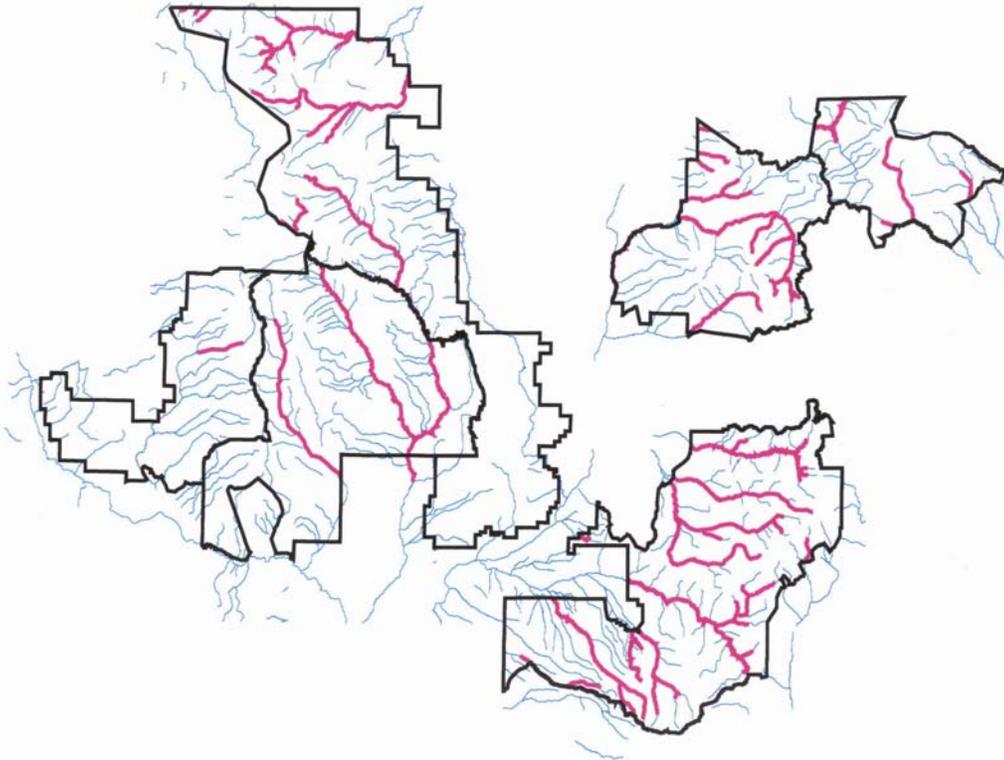
Rio Grande cutthroat trout's (RGCT) historic range is not known, although it likely encompassed all waters presently capable of supporting trout in the Rio Grande drainage. The distribution of the Rio Grande cutthroat trout has declined to 9 percent of its former range in New Mexico (Duff 1996). Currently, the species is restricted primarily to headwater tributaries within its historic range. 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 63 in the Sangre de Cristo Mountains, 13 in the Jemez Mountains, 4 in the San Juan Mountains, and one in the Black Range (Sublette 1990).

RGCT prefers clear, cold streams, with deep pools and consistent water flow, as well as, lakes. Population densities are regulated mostly by stream size and morphology (Koster 1957).

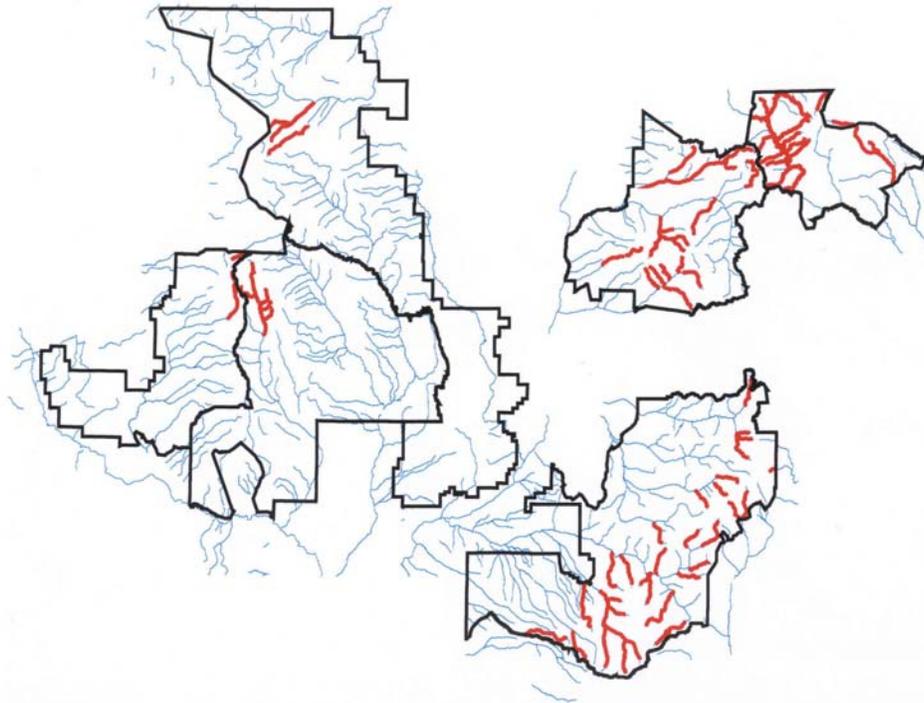
Deeper pools provide overwintering habitat, and consistent flows are important. Stream productivity is a reflection of general water quality. Substrates with clean gravels of various sizes and with little embeddedness provide for macroinvertebrate production as a consistent food source. Clean gravel 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 C. Optimum habitat includes the absence of and protection from non-native trout species, such as brown, rainbow, and brook trout.

Potential Habitat Distribution

Approximately 440 miles of perennial stream on the Carson National Forest is known habitat for resident trout (Forest GIS Stream Inventory 2002). Rainbow, brown or brook trout occupy about 50 percent (~225 miles) of that habitat (Map 1) along with ~ 50 miles of stream that is also occupied by Rio Grande cutthroat trout. Approximately 269 miles of perennial stream on the Carson National Forest is known habitat for the Rio Grande cutthroat trout (Map 2) and 190 miles is potential habitat (Forest Inventory GIS Data 2002).



Map 1. Rainbow, Brown, Brook Trout and Overlap Rio Grande Cutthroat Trout Habitat Distribution on the Carson National Forest (Forest Inventory GIS Data 2002)



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:

Whirling Disease

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. Whirling disease is a parasite that causes fish to swim erratically (whirl), and have difficulty feeding and avoiding predators. In severe infections, the disease can produce 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 (USDI 2002).

Trout native to the United States did not evolve with whirling disease. Consequently, most native species have little or no natural resistance. All of the resident trout on the Carson National Forest are threatened by whirling disease, with the Rio Grande cutthroat and rainbow trout being the most severely impacted. The parasite has now been confirmed in three drainages that support resident trout: South Fork Rio Grande, Rio Grande, and Conejos. It is likely the parasite will continue to spread to more and more streams, as animals and humans easily transport the spores. In New Mexico all whirling disease positive fish are destroyed.

Overutilization

Angler pressure can impact rainbow, brown, and brook trout populations in localized areas. There is no commercial fishing for resident trout. Angling for all resident trout is regulated by the New Mexico Department of Game and Fish, with reduced bag limits and/or “catch and release” for RGCT. Because regulations in New Mexico allow trout fishing, recreational angling is not considered a threat to the species.

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 high understory densities. As a result, under the right 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.

Long-term drought can affect existing populations of resident trout as well. Water is becoming scarce in some reaches of the Carson National Forest, as streams experience nearly 7 years of drought.

Non-native Trout

The introduction of non-native trout species has had a negative effect on native trout, such as the Rio Grande cutthroat trout. Current resident trout populations occupy most of the historic "trout" waters.

Habitat loss

Degradation and alteration of trout habitat has occurred from activities such as road building, grazing, recreation, irrigation, and dam development. These activities can result in sedimentation, increased fluctuation in temperatures, less woody debris, and unnatural flow rates. Changes in water quality parameters such as low pH, high temperatures, and persistent sedimentation are detrimental to resident trout. The drought conditions on the Carson National Forest during the late 1990's through 2004 have resulted in some temporary habitat loss for these species.

Positive: Enhancement of riparian habitats and upland watersheds through proper grazing management, road closures, stream habitat structures, and the application of best management practices benefit all resident trout. The development of the Long-range Plan for the Management of the Rio Grande Cutthroat Trout in New Mexico (NMDGF 2002b) has benefited this species. Fish barriers are viewed as a short-term protection, with the ultimate goal of protecting additional stream miles and drainages. Other management activities which benefit only RGCT include: mechanically removing non-native trout in mixed composition populations and restoring habitat and reintroducing populations within historic ranges.

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 (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 (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 (Wildlife & Fish Habitat – 13).

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

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

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

Standards and Guidelines for **Management Area 14--Riparian** include, "(m)anage for these indicator species: resident trout (cutthroat)..." (USDA 1990, 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 2002b).
- *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)
- *Outstanding National Resource Waters* (ONRW) designation of the streams within Valle Vidal of the Carson National Forest incorporates the Antidegradation Policy, which is referenced in the NM Water Quality Standards (20.6.4.8 NMAC). The policy states, "No degradation shall be allowed in high quality waters designated by the Commission as outstanding national resource waters." The Antidegradation Implementation Procedures

establishes three categories of waters, called “tiers”. The tier designation requires different levels of review and allows different levels of degradation. Waters designated as ONRW are assigned a “tier 3” designation.

HABITAT CONDITION AND TREND ON THE CARSON NATIONAL FOREST

Rainbow, brook, and brown trout tend to have a wider range of tolerance for habitat conditions than the Rio Grande cutthroat trout; therefore they are more widely distributed. Sedimentation of the substrate reduces spawning habitat and is usually caused by various activities, such as road building, grazing, fire, irrigation, etc. Overall, most areas of the Carson National 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.

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 trout 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 trout 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 70 to 100 miles of road per year. Since 2000, the Forest has decommissioned an average of 25 miles per year. Many of the current pure, stable, and secure populations of RGCT occur at elevations where timber harvest has not occurred, thus their habitat has 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 2002b).

NM Department of Game and Fish and Forest Service biologists have assessed habitat condition in streams with pure, stable and secure populations of RGCT (NMDGF 2002b). Habitat 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 ranges 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.

Fish barriers are essential to separate RGCT from non-native trout. However, to be effective barriers must be checked and 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.

The Forest Service assesses barriers as part of its stream habitat inventory. Representative resident trout streams across the Carson National Forest were selected and a monitoring rotation developed to establish a monitoring regime. Habitat trend is developing as streams are revisited. Over 150 miles of stream have been inventoried for an array of habitat quality indicators since 2001 (see end of this section).

Comanche Creek has had habitat inventory completed twice since Valle Vidal was acquired by the Carson National Forest in 1983. The first survey was conducted in 1998 and it was again surveyed in 2005. Due to the improvement in management and the continued habitat restoration effort by the Forest and its many partners, comparison of the two surveys indicates the habitat to be stable, with an upward trend (USDA 2006.)

Land management practices have improved in recent years, with greater emphasis on habitat improvement. Although recovery of these habitats can be slow, the continued commitment to manage and restore watersheds will improve resident trout habitat over time. Physical habitat conditions related to forest management activities and **habitat trend for resident trout is stable.**

POPULATION TREND

Regional

Rainbow trout is the most widely cultured and stocked trout in North America and occurs across the majority of the United States and Canada. A number of stocked fish do survive in the stream habitats to become resident trout. 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 44 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".

The Rio Grande cutthroat trout 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). 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. Generally, the introduced trout species will out-compete the native cutthroat for food and space (Sublette et al. 1990). Rio Grande cutthroat also readily hybridizes with other spring spawning trout, such as rainbow trout and a subspecies of cutthroat trout (*O. clarki*), contaminating the genetics of pure RGCT populations (Sublette et al. 1990). 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.

New Mexico

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. In 2005, stocking levels were up to about 80% of the levels prior to the discovery of whirling disease in the state.

Based on Performance Reports, from 1997 through 2004, as required by the Federal Aid in Sport Fish Restoration act, resident trout populations fluctuate based on water levels and habitat availability due to water fluctuations (NMDGF 1998-2004). In stream systems where flows are more constant, populations are expected to remain constant

In New Mexico, the RGCT is listed as "S2" (i.e, imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state/province). Currently, 106 populations of Rio Grande cutthroat trout are estimated in New Mexico (NMDGF 2002b) and 161 in Colorado

(USDI 2002) in both streams and lakes (USDI 2002). All of these populations contribute in some way to the overall security of the range-wide population.

Carson National Forest

Rainbow, brown, and brook trout can be found in the streams shown in Map 1 (covering ~225 miles of streams). The New Mexico Department of Game and Fish continues to stock these species in various locations on the Forest (NMDGF 2006 personal contact).

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. 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.

Table 1. Streams Actively Managed for RGCT on the Carson National Forest

| 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 |

Thirteen populations were 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 3 displays streams with pure, stable and secure populations of Rio Grande cutthroat trout on the Carson National Forest.

Table 2. Pure and Stable RGCT Populations on Carson National Forest

| Stream | Ranger District |
|---------------------|-----------------|
| El Rito Creek | El Rito |
| Bitter Creek | Questa |
| Columbine Creek | Questa |
| San Cristobal Creek | Questa |
| Powderhouse Creek | Questa |

| Stream | Ranger District |
|------------------|-----------------|
| Policarpio Creek | Camino Real |

Although unrelated to forest management activities, resident trout has likely lost some populations due to the recent drought years and drying up of some head waters. These can likely recover over time.

Given the nature of trout stocking on the Carson National Forest, the population trend for resident trout species is stable. This does not necessarily confirm what the Forest Plan predicts of resident trout populations over the course of plan implementation – "...populations are expected to increase because of improved habitat condition" (USDA 1986c, p. 238). Although population surveys for all resident trout have been conducted and are continuing, stocking programs can over shadow apparent trend data in areas where stocking takes place. Since the preparation of the 2003 MIS assessment, over 20 stream systems have been inventoried or reinventoried.

REFERENCES

- 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.
- 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.
- 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.
- NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available: <http://www.natureserve.org/explorer>. (Accessed: July 29, 2005 for Brook, Brown, Rainbow, and Rio Grande Cutthroat Trout).
- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available: <http://www.natureserve.org/explorer>. (Accessed: March 20, 2007 for Brook, Brown, Rainbow, and Rio Grande Cutthroat Trout).
- New Mexico Department of Game and Fish. 1998. Investigations of trout management strategies. Final Report, 6 May, 1998: Grant F-60-M/Project 13. Santa Fe, NM: New Mexico Department of Game and Fish. 22 p.
- New Mexico Department of Game and Fish. 1999. Investigations of trout management programs. Performance Report, 22 February, 1999: Grant F-60-M/Project 6. Santa Fe, NM: New Mexico Department of Game and Fish. 7 p.
- New Mexico Department of Game and Fish. 2000. Investigations of trout management programs. Performance Report, 19 September, 2000: Grant F-60-M-7/Project 06. Santa Fe, NM: New Mexico Department of Game and Fish. 7 p.
- New Mexico Department of Game and Fish. 2001. Investigations of trout management programs. Performance Report: Grant F-60-M/Project 06. Santa Fe, NM: New Mexico Department of Game and Fish. 34 p.
- New Mexico Department of Game and Fish. 2002a. Investigations of trout management programs. Performance Report: Grant F-60-M-7/Project 06. Santa Fe, NM: New Mexico Department of Game and Fish. 4 p.

- New Mexico Department of Game and Fish. 2002b. 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.
- New Mexico Department of Game and Fish. 2003. 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.
- New Mexico Department of Game and Fish. 2004. 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.
- New Mexico Department of Game and Fish. 2005. 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. Available: http://fwie.fw.vt.edu/states/nmex_main/species/010575.htm (Accessed: 29 July 2005 for Brown, Rainbow, and Rio Grande Cutthroat Trout).
- New Mexico Department of Game and Fish. 2007. 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. Available: www.bison-m.org (Accessed: 21 March 2007 for Brown, Brook, Rainbow, and Rio Grande Cutthroat Trout).
- New Mexico Department of Game and Fish. 2006. Personal Contact with Eric Frey, Northeast Area Fisheries Manager. Raton, 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.
- Sublette, James; Hatch, Michael D.; Sublette, Mary. 1990. The fishes of New Mexico. Albuquerque, NM: University of New Mexico Press. 393 p.
- 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. 1986c. Carson National Forest land and resource management plan. Albuquerque, NM: US Department of Agriculture, Forest Service, Southwestern Region.
- USDA Forest Service. 1990. Carson National Forest Plan (Amended). Forest Service, SW Region (Region 3), Albuquerque, NM. 348p.
- 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.
- USDA Forest Service. 1994. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 1995. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished.

- USDA Forest Service. 1996. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 1997. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 1998. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 1999. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 2000. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 2001. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 2002. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 2003. Fish monitoring on the Carson National Forest. Taos, NM: US Department of Agriculture, Forest Service, Southwestern Region, Carson National Forest. Unpublished report.
- USDA Forest Service. 2006. Comanche Creek stream habitat inventory report Carson National Forest, Taos New Mexico. Unpublished document.
- USDI Fish and Wildlife Service. 1998. Endangered and threatened wildlife and plants: 90-day finding for a petition to list the Bonneville Cutthroat Trout as threatened. December 8, 1998 Federal Register 63(235): 67640-67642.
- USDI Fish and Wildlife Service. 2002. Endangered and threatened wildlife and plants: candidate status review for Rio Grande cutthroat trout. June, 11 2002 Federal Register 67(112): 39936-39947.