DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[FWS–R2–ES–2008–0056; 1111 FY07 MO–B2]

Endangered and Threatened Wildlife and Plants; Status Review for Rio Grande Cutthroat Trout

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of candidate status review.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce the results of the status review for the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) under the Endangered Species Act of 1973 (Act), as amended. After a thorough review of all available scientific and commercial information, we find that listing the Rio Grande cutthroat trout is warranted but precluded by higher priority actions. Upon publication of this status review, we will add the Rio Grande cutthroat trout to our list of candidate species with a listing priority number of 9, because the threats affecting it have a moderate magnitude and are imminent. We will develop a proposed rule to list the subspecies as our priorities allow. We ask the public to continue to submit to us any new information that becomes available concerning the status of or threats to the subspecies. This information will help us to monitor and encourage the ongoing conservation of this subspecies.

DATES: The finding announced in this document was made on May 14, 2008.

ADDRESSES: This finding is available on the Internet at *http://www.regulations.gov.* Supporting documentation we used in preparing this finding is available for public inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, 2105 Osuna Road, NE., Albuquerque, New Mexico 87113; telephone (505) 346–2525; facsimile (505) 248–6788. Please submit any new information, materials, comments, or questions concerning this finding to the above address or via electronic mail (e-mail) at *r2fwe_al@fws.gov.*

FOR FURTHER INFORMATION CONTACT: Wally ''J'' Murphy, Field Supervisor, U.S. Fish and Wildlife Service, 2105 Osuna Road, NE., Albuquerque, New Mexico 87113. (505) 346–2525 ext 106. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(B) of the Act (16 U.S.C. 1531 *et seq.*) requires that, for any petition containing substantial scientific and commercial information that listing may be warranted, we make a finding within 12 months of the date of receipt of the petition on whether the petitioned action is: (a) Not warranted, (b) warranted, or (c) warranted, but that immediate proposal of a regulation implementing the petitioned action is precluded by other pending proposals to determine whether species are threatened or endangered, and expeditious progress is being made to add or remove qualified species from the Lists of Endangered and Threatened Wildlife and Plants. Section 4(b)(3)(C) of the Act requires that we treat a petition for which the requested action is found to be warranted but precluded as though resubmitted on the date of such finding, that is, requiring a subsequent finding to be made within 12 months. We must publish these 12-month findings in the **Federal Register**.

Previous Federal Actions

On February 25, 1998, we received a petition from Kieran Suckling, of the Southwest Center for Biological Diversity requesting that the Service add the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) to the list of threatened and endangered species. The petition addressed the range-wide distribution of the Rio Grande cutthroat trout that includes populations in Colorado and New Mexico. We subsequently published a notice of a 90-day finding in the **Federal Register** (63 FR 49062) on September 14, 1998. In the 90-day finding we concluded that the petition did not present substantial information indicating that listing of the Rio Grande cutthroat trout may be warranted.

On June 9, 1999, a complaint was filed by the Southwest Center for Biological Diversity alleging that the September 14, 1998, 90-day petition finding violated the Administrative Procedure Act. While the litigation was pending, we received information (particularly related to the presence of whirling disease in hatchery fish in the wild) that led us to believe that further review of the status of the subspecies was warranted. On November 8, 2001, a settlement agreement executed by both parties (the Service and the Southwest Center for Biological Diversity) was filed with the court. The settlement stipulated that the Service would initiate a status review for the Rio Grande cutthroat trout, make a determination on or before June 4, 2002, and shortly thereafter, publish our determination in the **Federal Register**. On June 11, 2002, we published our determination that listing of Rio Grande cutthroat trout was not warranted (67 FR 39936).

Subsequently, on February 25, 2003, the Center for Biological Diversity, along with several other organizations, sued the Service for failing to list Rio Grande cutthroat trout. On June 7, 2005, the New Mexico Federal District Court (Court) ruled that our finding was not arbitrary and capricious, but also required that we explain in more detail our analysis of ''significant portion of the range''. The Court ordered the Service to provide a supplemental briefing discussing in more detail our analysis of significant portion of the range. We submitted this briefing on July 20, 2005. On December 19, 2005, the Court ruled in favor of the Service and upheld our interpretation of significant portion of the range and determined that our evaluation of Rio Grande cutthroat trout's status under the listing criteria was not arbitrary and capricious. Plaintiffs appealed this decision.

The appeal was pending with the Tenth Circuit Court of Appeals, when other courts issued opinions for other species that required the Service to reexamine our position on significant portion of the range. On March 16, 2007, a formal opinion was issued by the Solicitor of the Department of the Interior, ''The Meaning of In Danger of Extinction Throughout All or a Significant Portion of Its Range'' (U.S. DOI 2007). Because of this new formal opinion and because of our knowledge of changes in status of some populations that we had defined as ''secure'' in our 2002 review, in consultation with the court and the plaintiffs, the Service agreed to initiate a new status review. We subsequently published a notice seeking new information concerning the status of Rio Grande cutthroat trout on May 22, 2007 (72 FR 28664).

In response to our 2007 requests for information regarding Rio Grande cutthroat trout (72 FR 28664, 72 FR 46030 (August 16, 2007)), we received comments and information from Colorado Division of Wildlife (CDOW), New Mexico Department of Game and Fish (NMDGF), U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), private citizens and organizations, and the Rio Grande Cutthroat Trout Conservation Team. The Rio Grande Cutthroat Trout

Conservation Team is composed of biologists from CDOW, NMDGF, BLM, USFS, National Park Service, the Jicarilla Apache Nation and the Service. The Rio Grande Cutthroat Trout Conservation Team recently completed a range-wide status report (Alves *et al.* 2007) concerning the Rio Grande cutthroat trout. The status report and the comprehensive database (referred to as ''2007 database'' in this finding) that is the basis for the report, along with other supplemental submissions from the agencies listed above, provide the best scientific and commercial information available on Rio Grande cutthroat trout. The report summarizes information provided by 15 fisheries professionals from Colorado and New Mexico having specific knowledge of Rio Grande cutthroat trout (Alves *et al.* 2007, p. 58). In making this finding, we considered all scientific and commercial information that we received or acquired since our previous status review. We relied primarily on published and peer-reviewed documentation for our conclusions.

Biology and Distribution

The Rio Grande cutthroat trout, one of 14 subspecies of cutthroat trout, is native to the Rio Grande, Pecos, and the Canadian river basins in New Mexico and Colorado (Behnke 2002, p. 219). Rio Grande cutthroat trout has the distinction of being the first North American trout recorded by Europeans (Behnke 2002, p. 139). In 1541, Francisco de Coronado's expedition discovered Rio Grande cutthroat trout in the upper Pecos River (Behnke 2002, p. 139). The first specimens that were collected for scientific purposes came from Ute Creek in Costilla County, Colorado, in 1853. Rio Grande cutthroat trout was originally described in 1856 (Behnke 2002, p. 210). Cutthroat trout subspecies are distinguished by the red to orange slashes in the throat folds beneath the lower jaw.

The historical distribution of Rio Grande cutthroat trout is not known with certainty. In general, it is assumed that Rio Grande cutthroat trout occupied all streams capable of supporting trout in the Rio Grande, Pecos, and Canadian basins (Alves *et al.* 2007, p. 9). The Pecos River is a tributary of the Rio Grande, so a historic connection between the two basins likely existed. Although no early museum specimens document its occurrence in the headwaters of the Canadian River, it is almost certainly native there as well (Behnke 2002, p. 208). The Canadian River, tributary to the Mississippi River, has no connection with the Rio Grande. It is possible that through headwater capture (a tributary from one watershed joins with a tributary from another) there may have been natural migration of fish between the Pecos and Canadian headwater streams. There is evidence that Rio Grande cutthroat trout may have occurred in Texas (Garrett and Matlock 1991, p. 405; Behnke 1967, pp. 5, 6) and Mexico (Behnke 1967, p. 4). Currently, the southernmost distribution of Rio Grande cutthroat trout occurs in Animas Creek, Sierra County, New Mexico, and Indian Creek on the Mescalero Apache Indian Reservation in Otero County, New Mexico. Distribution in the southern portion of the range is currently limited and no conservation populations (see discussion of conservation populations below) exist south of Santa Fe, New Mexico.

In the range-wide status report, historically occupied habitat was based on habitat believed to be inhabited by Rio Grande cutthroat trout when early European explorers entered the Southern Rocky Mountain Region of Colorado and New Mexico (circa 1800) (Alves *et al.* 2007, p. 9). In general, streams currently capable of supporting trout (elevations of 1,829 meters (m) (6,000 feet (ft)) and above; 1,671 m (5,500 ft) and above on north-facing slopes) were assumed to have been historically occupied if they were not above a barrier to fish movement (*e.g.*, an impassable waterfall). Streams which cannot currently support trout were assumed not to have been historically occupied unless they were known to have been degraded by such things as water withdrawals, channel alterations, human-caused barriers, or chemical contamination. Based on these criteria, 10,622 kilometers (km) (6,660 miles (mi)) of stream habitat were identified as having the potential of being historically occupied by Rio Grande cutthroat trout (Alves *et al.* 2007, p. 9). The estimated amount of historical range in each State is about 5,196 km (3,229 mi) in Colorado (48 percent), and 5,521 km (3,431 mi) (52 percent) in New Mexico (Alves *et al.* 2007, p. 9).

To facilitate management and conservation efforts, the Rio Grande cutthroat trout range is divided into Geographic Management Units (GMUs) based on watersheds (Alves *et al.* 2007, p. 2). The GMUs are, from north to south, Rio Grande headwaters, Lower Rio Grande, Canadian, Pecos, and Caballo. Historical occupancy by GMU is 5,277 km (3,279 mi) (49 percent) in Rio Grande Headwaters, 3,396 km (2,110 mi) (32 percent) in Lower Rio Grande, 1,027 km (638 mi) (10 percent) in the Canadian, 1,003 km (623 mi) (9 percent) in Pecos, and 16 km (10 mi) (0.2 percent) in Caballo (Alves *et al.* 2007, p. 9).

In our prior status review (67 FR 39936; June 11, 2002), we focused our analysis primarily on ''core'' populations, which we defined using conservative criteria for genetic integrity, population stability, and security from invasion by nonnative salmonids (trout and salmon). The genetic criterion for these core populations was that the populations have less than one percent representation of genetic markers from another subspecies of cutthroat trout or from rainbow trout (*Oncorhynchus mykiss*), as determined by genetic testing. Rio Grande cutthroat trout are able to interbreed, or hybridize, with other subspecies of cutthroat trout and rainbow trout. This hybridization may result in genes of one species or subspecies being incorporated into the other species or subspecies. The incorporation of genes from one species into another is referred to by the technical term ''introgression'' (Mayr 1970) and a species that has received such genes is referred to as ''introgressed.'' To simplify discussion in this review, we will also use these terms when describing when genetic markers of another subspecies are found in Rio Grande cutthroat trout, although we recognize that these terms, as strictly defined, refer to species.

Our previous status review concluded that the core populations, as then defined by conservative criteria, were sufficiently abundant, distributed, and secure to conclude that listing of the Rio Grande cutthroat trout was not warranted. As described later in this review, the status of several of the original core populations has subsequently declined and we believe those populations alone are not sufficient to conserve the Rio Grande cutthroat trout.

For the current review, the genetic criterion for core populations is that they be less than one percent introgressed, which is the same genetic criterion for core populations followed in the previous review. Although population stability and security from invasion are not used to define core populations, as they were in the previous review, those factors are still addressed as attributes affecting the status of core and other populations. Core populations in the current review correspond to the core populations described in the multi-state position paper for cutthroat management (Utah Division of Wildlife Resources (UDWR) 2000, pp. 3, 4). In addition to these core populations, we focused our review on ''conservation populations'' as defined by the position paper (UDWR 2000): populations less than 10 percent introgressed, as measured by genetic markers, and that retain the ecological, behavioral, and phenotypic characteristics of Rio Grande cutthroat trout. In addition, we have included as conservation populations those populations which have not been genetically tested, but that retain the ecological, behavioral, and phenotypic characteristics of Rio Grande cutthroat trout and are not suspected to be introgressed or co-occurring with hybridizing species.

The above criteria for core and conservation populations have been applied in Service status reviews of other subspecies of cutthroat trout published since 2002 (71 FR 8818; 72 FR 32589). The status review (68 FR 46989; August 7, 2003) for the westslope cutthroat trout (*Oncorhynchus clarki lewisi*) included populations with up to 20 percent introgression, based on several studies of genetic markers and morphological traits of introgressed populations that indicate that populations with up to 20 percent of their nuclear genes derived from rainbow trout were morphologically indistinguishable from nonintrogressed westslope cutthroat trout populations. Comparable studies, where genetic and morphological characters in the same population are studied, have not been performed on Rio Grande cutthroat trout; therefore, we have no justification for departing from the general criterion of less than 10 percent introgression proposed in the position paper on cutthroat trout genetics (UDWR 2000).

In the remainder of this review, we collectively refer to both core and conservation populations, as defined above, as conservation populations.

Inclusion of conservation populations with up to 10 percent introgression in the present review does not mean we are any less concerned about the effects of introgression on Rio Grande cutthroat trout. Our evaluation of introgression as a threat to the Rio Grande cutthroat trout will be described along with other applicable threats later in this review.

Alves *et al.* (2007, p. 26) report that 120 conservation populations of Rio Grande cutthroat trout currently occupy about 1110 km (690 mi) of habitat, or 10.4 percent of the historical range of the subspecies. The 120 conservation populations include 12 populations that have not been tested for introgression and are suspected to be hybridized and one population that to date has tested as nonintrogressed but in which rainbow trout, a hybridizing species, co-occurs (Alves *et al.* 2007, p. 34; 2007 data base). An additional two streams (Placer Creek and Comanche Creek) included in the 120 are undergoing restoration and are currently unoccupied by Rio Grande cutthroat trout. Although we fully expect these two streams will become conservation populations within the next five years, they are not occupied by viable populations currently. Although we included in our analysis untested populations that are suspected to be nonintrogressed as conservation populations, we do not feel it is appropriate to include untested populations that are suspected to be introgressed or that co-occur with hybridizing species. Alves *et al.* (2007) provided all summary statistics (*e.g.*, percent populations with nonnative trout, percent historical habitat occupied, number of populations in each state) for 120 conservation populations. Although the inclusion of these populations in Alves *et al.* (2007) inflates the number of conservation populations and miles of stream occupied by Rio Grande cutthroat trout, their inclusion does not make a material difference in the outcome of our finding. Therefore, we have decided to present all summary statistics as presented in Alves *et al.* (2007) rather than recalculate the summary statistics to reflect the 105 populations we would classify as conservation populations.

Rio Grande cutthroat trout conservation populations currently occupy about 473 km (294 mi) in Colorado (9.1 percent of Colorado historical habitat) and 637 km (396 mi) in New Mexico (11.6 percent of historical habitat) (Alves *et al.* 2007, p. 26). The Lower Rio Grande GMU contains the largest amount of occupied habitat (489 km (304.1 mi)), followed by the Rio Grande Headwaters GMU (452 km (281.4 mi)), Canadian GMU (109 km (67.5 mi)), and Pecos GMU (60 km (37.3 mi)) (Alves *et al.* 2007, p. 26). The Caballo GMU contains a hybridized population of cutthroat trout that was not included as a conservation population. Rio Grande cutthroat trout occupy habitat in 14 of 19 watersheds that supported historical habitat. They are believed to be extirpated from the following watersheds: Arroyo Del Macho, Caballo, Upper Canadian, Rio Hondo, and Rio Penasco (Alves *et al.* 2007, p. 11). If Rio Grande cutthroat trout once occurred in Texas and Mexico, there is no evidence that they occur there now.

Life History

As is true of other subspecies of cutthroat trout, Rio Grande cutthroat trout is found in clear cold streams. Unlike some subspecies of cutthroat trout, such as the Bonneville (*Oncorhynchus clarki utah*) and Yellowstone (*Oncorhynchus clarki bouvieri*), Rio Grande cutthroat trout did not originally inhabit large lake systems. However, they have been introduced into coldwater lakes and reservoirs. They spawn as high water flows from snowmelt recede. In New Mexico, this typically occurs from the middle of May to the middle of June (NMDGF 2002, p. 17). Spawning is believed to be tied to day length, water temperature, and runoff (Sublette *et al.* 1990, p. 54; Behnke 2002, p. 141).

It is unknown if Rio Grande cutthroat trout spawn every year or if some portion of the population spawns every other year as has been recorded for westslope cutthroat trout (McIntyre and Rieman 1995, p. 1). Likewise, while it is assumed that females mature at age 3, they may not spawn until age 4 or 5 as seen in westslope cutthroat trout (McIntyre and Rieman 1995, p. 3). Sex ratio also is unknown with certainty, but based on field data, a ratio skewed towards more females might be expected (Pritchard and Cowley 2006, p. 27). Although Yellowstone (Gresswell 1995, p. 36), Bonneville (Shrank and Rahel 2004, p. 1532), and westslope (Bjornn and Mallet 1964, p. 73; McIntyre and Rieman 1995, p. 3) cutthroat trout subspecies are known to have a migratory life history phase, it is not known if Rio Grande cutthroat trout once had a migratory form when there was connectivity among watersheds.

Most cutthroat trout are opportunistic feeders, eating both aquatic invertebrates and terrestrial insects that fall into the water (Sublette *et al.* 1990, p. 54). Rio Grande cutthroat trout evolved with Rio Grande chub (*Gila pandora*), longnose dace (*Rhinichthys cataractae*) (all basins); Rio Grande sucker (*Catastomus plebius*) (Rio Grande Basin); white sucker (*C. commersoni*) and creek chub (*Semotilus atromaculatus*) (Pecos and Canadian Basins); and the southern redbelly dace (*Phoxinus erythrogaster*) (Canadian River Basin) (Rinne 1995, p. 24). Many of these fish have either been extirpated from streams with Rio Grande cutthroat trout or are greatly reduced in number (Sublette *et al.* 1990, p. 162; Calamusso and Rinne 1999, pp. 233–236). It is not known if they once were an important component of Rio Grande cutthroat trout diet. Other subspecies of cutthroat trout become more piscivorous (fish eating) as they mature (Moyle 1976, p. 139; Sublette *et al.* 1990, p. 54) and cutthroat trout living in lakes will prey heavily on other species of fish (Echo 1954, p. 244). It is possible that native cyprinids (i.e., chubs, minnows, and dace) and suckers may have once been important prey items for Rio Grande cutthroat trout. Growth of cutthroat trout varies with water temperature and availability of food. Most populations of Rio Grande cutthroat trout are found in high elevation streams. Under these conditions growth may be relatively slow and time to maturity may take longer than is seen in subspecies that inhabit lower elevation (warmer) streams.

Typical of trout, Rio Grande cutthroat trout require several types of habitat for survival: spawning habitat, nursery or rearing habitat, adult habitat, and refugial habitat. Spawning habitat consists of clean gravel (little or no fine sediment present) that ranges between 6 to 40 millimeters (mm) (0.24–1.6 inches (in)) (NMDGF 2002, p. 17). Nursery habitat is usually at the stream margins where water velocity is low and water temperature is slightly warmer. Harig and Fausch (2002, pp. 542, 543) found that water temperature may play a critical role in the life history of the young-of-year cutthroat. Streams with mean daily temperature in July of less than 7.8 °C (46 °F) may not have successful recruitment (survival of individuals to sexual maturity and joining the reproductive population) or reproduction in most years. Adult habitat consists of pools with cover and riffles for food production and foraging. Refugial habitat in the form of large deep pools is also necessary for survival. The primary form of refugial habitat is deep pools that do not freeze in the winter and do not dry in the summer or during periods of drought. Lack of large pools may be a limiting factor in headwater streams (Harig and Fausch 2002, p. 543). Refugial habitat may also be a downstream reach of stream or a connected adjacent stream that has maintained suitable habitat in spite of adverse conditions.

A technical review of Rio Grande cutthroat trout was recently completed (Pritchard and Cowley 2006) which covers the biology of the subspecies in greater detail and the reader is referred to that document for additional background information on the subspecies.

Summary of Factors Affecting the Subspecies

Section 4 of the Act and regulations (50 CFR 424) promulgated to implement the listing provisions of the Act set forth the procedures for adding species to the Federal list of endangered or threatened species. A species may be determined to be threatened or endangered due to one or more of the five factors described in section 4(a)(1) of the Act. The following analysis examines the listing factors and their application to Rio Grande cutthroat trout.

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Population Isolation and Fragmentation

The historic range of Rio Grande cutthroat trout has been greatly reduced over the last 150 years. Populations have been lost because of water diversions, stream drying, dams, habitat degradation, changes in hydrology, hybridization with rainbow trout, or competition with brown (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*) (Pritchard and Cowley 2006, pp. 16, 34–37; 67 FR 39939). Quantifying the exact magnitude of loss in either number of fish or habitat is difficult because there are no baseline data. Alves *et al.* (2007, p. 26) estimate that conservation populations occupy about 10 percent of historically inhabited stream miles. Also, the current distribution of occupied miles on the landscape differs from the historical distribution. The range has contracted northward, Rio Grande cutthroat trout are now restricted primarily to headwater streams, and the large connected networks that once linked hundreds of stream miles together no longer exist. The change in distribution is discussed briefly followed by a discussion of fragmentation which has modified and curtailed habitat.

Historically, 43 percent of Rio Grande cutthroat trout populations occupied streams 2,438 m (8,000 ft) or less in elevation (Alves *et al.* 2007, p. 18). Currently, only about 1.6 percent of the populations are in streams less than 2,438 m (8,000 ft) (Alves *et al.* 2007, p. 18). Conservation populations, as defined above, are now concentrated in elevations from 2,743–3048 m (9,000–10,000 ft) (Alves *et al.* 2007, p. 18). High-elevation streams (above 2,743 m (9,000 ft)) are subject to extreme and fluctuating environmental conditions including forest fires, freezing, and dewatering (Novinger and Rahel 2003, p. 779). In addition, headwater mountain streams often lack critical resources such as deep pools (Harig and Fausch 2002, p. 546) and provide insufficient refuge from catastrophic disturbance (Pritchard and Cowley 2006, p. 17). Because high-elevation headwater streams are narrow and small compared to the larger downstream reaches that Rio Grande cutthroat trout once occupied, the absolute loss of habitat in both quantity and quality is greater than stream miles might indicate.

Historically, many watersheds supporting Rio Grande cutthroat trout contained streams that were connected. For example, in Colorado, the Trinchera, Conejos, Culebra, Costilla, and Alamosa rivers would all have been connected through the upper Rio Grande, forming a vast network of streams (Alves *et al.* 2007, p. 10). As a consequence of habitat loss, each of these watersheds is now isolated from the other and Rio Grande cutthroat trout are restricted to fragments of streams (Alves *et al.* 2007, pp. 12, 29). Of the 120 conservation populations, 112 (representing 80 percent of occupied miles) are in isolated stream fragments (Alves *et al.* 2007, p. 29). No populations are considered to have strong connectivity (i.e., ≥ 5 connected streams with open migration corridors) (Alves *et al.* 2007, pp. 29, 77). One population has a moderate degree of connectivity (4 to 5 connected streams); however, this watershed (Comanche Creek) is currently under restoration and has very few fish present. Seven populations have very little connectivity (2–3 connected streams, infrequent straying of adults may occur) (Alves *et al.* 2007, pp. 29, 77). Because Rio Grande cutthroat trout habitat is severely fragmented and because the effects of fragmentation are considered one of the primary threats to Rio Grande cutthroat trout populations, the consequences of fragmentation are discussed in detail below.

Habitat fragmentation reduces the total area of habitat available, reduces habitat complexity, and prevents gene flow (Saunders *et al.* 1991, p. 25; Rieman and McIntyre 1995, p. 293; Burkey 1995, pp. 527, 528; Dunham *et al.* 1997, pp. 1126, 1127; Frankham *et al.* 2002, p. 310; Noss *et al.* 2006, p. 219). Fragmentation accelerates extinction, especially when movement of fish among fragments is not possible, as is the case with Rio Grande cutthroat trout (Burkey 1995, p. 540; Frankham *et al.* 2002, p. 314). Isolated populations are vulnerable to extinction through demographic stochasticity (random changes in the population structure, e.g., uneven male/female ratios); environmental stochasticity (random changes in the fishes' surroundings) and catastrophes (e.g., fires, stream drying, freezing); loss of genetic heterozygosity (genetic diversity) and rare alleles (inherited forms of a genetic trait); and human disturbance (Shaffer 1987, p. 71; Rieman *et al.* 1993, pp. 9–15; Burkey 1995, pp. 527, 528; Dunham *et al.* 1997, p. 1130; Frankham *et al.* 2002, pp. 310–324). Completely isolated fragments are the most severe form of fragmentation because the isolation prevents fish from mating with other fish carrying different genes, thereby preventing new genes from entering the isolated population (Frankham *et al.* 2002, p. 314). Of 120 Rio Grande cutthroat trout conservation populations, 112 (93 percent, 80 percent of occupied miles) exist as isolated segments or have very little connectivity (Alves *et al.* 2007, p. 29).

Apart from the isolation (lack of gene flow) that fragmentation causes, the short length of the fragments and small population size that they support are also of concern for Rio Grande cutthroat trout. Seventy-one percent of Rio Grande cutthroat trout conservation populations occupy stream segments of 8.1 km (5 mi) or less (median 6.2 km (4.2 mi)) (Alves *et al.* 2007, p. 26). Several researchers have found that population viability of cutthroat trout is correlated with stream length (Hilderbrand and Kershner 2000, p. 515; Young *et al.* 2005, p. 2405; Cowley 2007, DOI: 10.1002/aqc.845). Stream length is important because trout need a variety of habitats to complete their life cycle (i.e., spawning habitat, rearing habitat, adult habitat, refugial habitat) (Rieman and McIntyre 1995, p. 293; Horan *et al.* 2000, p. 1251; Harig and Fausch 2002, p. 546; Young *et al.* 2005, p. 2406). The shorter the stream, the more likely it is that one or more of the Rio Grande cutthroat trout's required habitats is either missing, or inadequate for completion of the species life cycle (Hilderbrand and Kershner 2000, p. 513). This is particularly true in high-elevation streams which are narrower and shallower than larger, lower elevation, streams. The longer a stream is, the more complexity it encompasses and the higher the probability that no particular habitat type limits the population.

Hilderbrand and Kershner (2000, p. 515) estimated 8.3 km (5.1 mi) were required to maintain a population of 2,500 cutthroat trout when fish abundance was high (0.3 fish/m (0.09 fish/ft)). Adding a 10 percent loss rate, to account for emigration and mortality, increased the length up to 9.3 km (5.8 mi) in order to maintain 2,500 fish. For abundances of 0.2 fish/m (0.06 fish/ft) and 0.1 fish/m (0.03 fish/ft), the corresponding length increased to 12.5 km (7.8 mi) and 25 km (15.5 mi), respectively (assuming no losses) (Hilderbrand and Kershner 2000, p. 15). Young *et al.* (2005, p. 2405) found that to maintain a population of 2,500 cutthroat trout, 8.8 km (5.5 mi) of stream were needed. Cowley (2007 DOI: 10.1002/aqc.845) determined that in stream widths of approximately 2 m (6.6 ft) (average width of most Rio Grande cutthroat trout streams), a stream length of 11 km (6.8 mi) would be needed to support a population of 2,750 fish. Because the majority (71 percent) of Rio Grande cutthroat trout conservation populations occur in short stream fragments of 8.1 km (5 mi) or less, these studies indicate that stream fragmentation (resulting in short stream lengths) pose a threat to Rio Grande cutthroat trout conservation populations.

Longer streams support larger populations (Harig and Fausch 2002, p. 546; Young *et al.* 2005, p. 2405). Population size is a major determinant of species persistence (Reed *et al.* 2003, p. 23). Population persistence decreases as population size decreases (Rieman and McIntyre 1993, p. 15). Long-term persistence of a population depends on having a sufficient number of individuals to avoid inbreeding depression, which decreases population viability, and to maintain genetic variation (Franklin 1980, pp. 135–148; Frankham *et al.* 2002, pp. 190–192; Reed 2005, pp. 563, 564). Genetic variability within a population is necessary for adaptability (Reed 2005, p. 564; Cowley 2007 DOI: 10.1002/aqc.845). Genetic variation will be lost through time in isolated populations and the loss occurs more quickly in small populations than in large populations (Rieman and Allendorf 2001, p. 761). When a population is greatly reduced in size (bottlenecked), genetic diversity is decreased (Frankham *et al.* 2002, p. 183)

In our previous status review (67 FR 39938), we concluded that a population size of 2,500 fish would ensure long-term persistence of Rio Grande cutthroat trout, i.e., would reduce the risks associated with small population size alone. Since that time other peer-reviewed literature has been published that allows us to further evaluate this number. Reed *et al.* (2003, p. 30), in a review of 102 vertebrate species, estimate that sufficient habitat should be present to allow for approximately 7,000 breeding age adults in order to ensure long-term species persistence. Cowley (2007 DOI: 10.1002/aqc.845) found that a population size of 2,500 Rio Grande cutthroat trout failed to meet the desired long-term effective population size (number of adults actually contributing offspring to the population) of at least 500. A minimum population size of 2,750 was sufficient if there was infrequent loss of year classes (all the individuals of a population of fishes born or hatched in the same year). He found that a larger population size was required as survival rate of young fish (one year or less) decreased. He concluded that managing for Rio Grande cutthroat trout population sizes in the range of 8,000 to 16,000 would be more likely to ensure population viability when there are low to intermediate survival rates of young fish. While any population number we might use to assess the status of the subspecies is unlikely to satisfy all interested parties, we believe 2,500 continues to be a reasonable standard by which to evaluate the populations. While the range of acceptable standards may range from 2,500 to 16,000, there is relative certainty that populations below 2,500 are likely at risk and may not be contributing to long-term persistence of the subspecies.

In 2007, fifteen of the 120 conservation populations had 2,500–7,000 Rio Grande cutthroat trout. The 120 conservation populations occur in 161 individual streams. Several conservation populations occupy multiple individual stream segments that are connected, thus the numbers of occupied streams segments is larger than the total number of conservation populations. Of those 161 individual streams, a minimum of 53 contain populations of under 500 reproducing adult fish. Because population estimates are unavailable for 38 streams, and most of the 38 are short segments (2007 database), the total number of populations with fewer than 500 reproducing adult fish is much likely greater than 53. Of the 99 conservation populations with quantitative estimates, 19 have an abundance of 0–0.03 fish/m (0–50 fish/mi) and 31 have an abundance of 0.03–0.09 fish/m (50–150 fish/mi). These low abundances indicate that on average, Rio Grande cutthroat trout need longer, rather than shorter, stream segments to ensure their long-term persistence because longer streams support larger numbers of fish (Hilderbrand and Kershner 2000, p. 515).

In 2002, we identified 13 Rio Grande cutthroat trout populations as secure (67 FR 39940). All 13 had populations over 2,500, contained no nonnative trout, and were protected from invasion by nonnative fish by a barrier. By 2007, 5 of these populations had fewer than 1,000 fish and 3 others had fewer than 2,000. One of the populations (approximately 13,000 fish in 2002) is thought to have been extirpated by low water effects (the stream either dried or froze). Brown trout were discovered above the barrier on one of the streams. The status of only 5 populations remained unchanged between 2002 and 2007.

A ''general health assessment'' was used by Alves *et al.* (2007, pp. 41–43) to look at the health of individual populations. Sixty-eight populations (798 km (496 mi)) were judged to have a moderately high degree of health, 50 (264 km (164 mi)) moderately low, and 1 (3.2 km (2 mi)) ranked as having low health (Alves *et al.* 2007, p. 42). Four factors were considered in the assessment: isolation, temporal variability (a measure of variability in the physical environment which correlates with stream length), population size, and population production (a composite score based on habitat condition, presence of nonnatives, and disease) (Alves *et al.* 2007, pp. 82, 83, 89). These factors were weighted in the following order: isolation (0.5), stream length (0.7), population size (1.2), and population production (1.6). The first 3 factors have a range of 1 to 4, while the last, population production, has a range of 2 to 8 (Alves *et al.* 2007, p. 89), effectively doubling its importance beyond the greater weighting (1.6) assigned to it. Rationale for the weighting scheme is not provided. Many scoring systems could be devised to determine population health and it is unclear why isolation and stream length, two factors that have been discussed extensively in conservation biology and cutthroat trout conservation literature (e.g., Saunders *et al.* 1991, pp. 18–26; Dunham *et al.* 1997, p. 1130; Hilderbrand and Kershner 2000, p. 513; Frankham *et al.* 2002, Chapter 13; Young *et al.* 2005, p. 2405; Noss *et al.* 2006, Chapter 7) were assigned the lowest weights. This rating system is heavily biased towards production and does not provide a balanced assessment of population health. However, even with this unbalanced health assessment, only one stream ranked as having high health, Comanche Creek. A major restoration of Comanche Creek began in 2007, and while we fully expect it to be restocked with nonintrogressed Rio Grande cutthroat trout in the future, it has no Rio Grande cutthroat trout currently.

It has been argued that small, isolated populations have persisted for decades (Patten and Sloane 2007, p. 3). However, Rio Grande cutthroat trout populations have only been monitored and intensively managed during the last 50 years or less, and habitat conditions and stressors are very different from historic conditions. Consequently, long-term persistence cannot be appropriately assessed. In addition, as Hilderbrand and Kershner state (2000, p. 517), although some isolated populations may have persisted for centuries, these populations are probably exceptions. To assume all isolated populations will behave similarly may lead to insufficient protection (Hilderbrand and Kershner 2000, p. 517).

Based on the arguments presented above, we determined that stream length, population size, and absence of nonnative trout are the most important criteria by which to evaluate long-term population persistence. We have evaluated the status of Rio Grande cutthroat trout conservation populations primarily on stream length (9.6 km (6 mi) or greater), population size (more than 2,500 fish), and presence or absence of nonnative fish (Tables 1 and 2). All streams with a length of over 9.6 km (6 mi) were initially evaluated. Stream miles in Tables 1 and 2 include all miles in the conservation population when more than one stream is connected. Habitat condition and presence of a barrier are also presented in Tables 1 and 2 because these factors are also considered important in evaluating the status of the populations. Eight streams (4 in Colorado, 3 in New Mexico, one shared) currently have over 2,500 fish, are 9.6 km (6 mi) or longer, and have no nonnative fish present (Table 1). In addition, the main stem of these streams is greater than 1.5 m (5 ft) (although tributaries to the main stem may be less than this width) and all have abundances of 151 fish per mile or greater. Five of the streams, Cross, Medano, San Francisco, Canones, and El Rito creeks, were identified as secure in 2002. Although these eight streams meet the criteria, some have characteristics that are less than optimal (Table 1). For instance, habitat quality in Cross and Canones creeks is judged as ''Fair.'' In Canones Creek, the percentage of pools (9 percent) is low and it was found to be at risk by Santa Fe National Forest temperature standards (Ferrell 2006) (discussed in more detail in the ''Climate Change'' section below).

TABLE 1.—RIO GRANDE CONSERVATION POPULATIONS WITH UNALTERED (< 1%) GENETIC STATUS OCCURRING IN STREAM LENGTHS GREATER THAN 9.6 KM (6 MI), WITH GREATER THAN 2,500 FISH, AND NO NONNATIVE TROUT PRESENT

	Population size	Length in km (mi)	Habitat condition	Ownership	State	Barrier
San Francisco Creek	3,820	23.5 (14.6)	Excellent	USFS, Private	CO	Water diversion.
Torcido Creek	6,042	16.7 (10.4)	Good	Private	CO	Drying.
Medano Creek	5,795	33.6 (20.9)	Excellent	NPS, USFS	CO	None.
Cross Creek	3,675	12.9 (8.0)	Fair	BLM, USFS, Private	CO	None.
Costilla Creek	5,200	21.1 (13.1)	Excellent	Private	NM, CO	Temporary/Manmade.
Alamitos Creek	3,080	11.4 (7.1)	Good	USFS	NM	Partial/Water diversion.
El Rito Creek	4,401	10.3 (6.4)	Good	USFS	NM	Temporary/Manmade.
Canones Creek	3,683	9.7 (6.0)	Fair	USFS	NM	Waterfall.

Table 2 shows all the other Rio Grande cutthroat trout conservation populations in stream lengths greater than 9.6 km (6 mi). Six of the populations have more than 2,500 Rio Grande cutthroat trout, but all of these have nonnative brook trout present as well. In addition, 4 of these have habitat quality judged as fair and one is in a stream with a width less than 1.5 m (5 ft) wide, which puts it at risk for drying (as discussed below). Abundance (fish per mile) is provided in Table 2 because some of these have less than 150 fish per mile, and, as mentioned above, for populations with 0–50 or 50–150 fish per mile, a longer stream length would be needed to ensure long-term persistence. It should also be noted that Sangre de Cristo Creek has tested positive for whirling disease. For all of these reasons, although the Rio Grande cutthroat conservation populations presented in Table 2 occur in stream lengths greater than 9.6 km (6 mi), all appear at risk for one or more reasons. Two additional streams (Osier and Cascade) have strong populations 3,239 and 2,372, respectively, with no nonnative trout present. However, stream length for Osier Creek is only 5.9 km (3.7 mi) and for Cascade it is 4.7 km (2.9 mi). While these populations do currently contribute to the status of the subspecies range-wide, they are considered too short to ensure long-term persistence as their shorter length makes them more vulnerable to extirpation from ash flow or other localized disturbance.

TABLE 2.—RIO GRANDE CONSERVATION POPULATIONS IN STREAM LENGTHS GREATER THAN 9.6 KM (6 MI), SORTED BY POPULATION SIZE. NONNATIVE SPECIES MAY BE PRESENT OR ABSENT. BRK = BROOK TROUT, BRN = BROWN TROUT, WS = WHITE SUCKER

Stream name	Population size	Abundance (fish per mile)	Length in km (mi)	Nonnatives present	Habitat condition	Width in feet	State	Barrier
Jacks Creek	4,849	> 400	18.5 (11.5)	BRK	Fair	< 5	CO	Drying.
Cabresto Creek	4,570	> 400	13.7 (8.5)	BRK	Fair	5 to 10	NM	Diversion.
Sangre de Cristo Creek	3,793	151 to 400	36.2 (22.5)	BRK	Fair	5 to 10	CO	Partial/Diversion.
South Carnero Creek	3,748	151 to 400	22.9 (14.2)	BRK, BRN, WS.	Fair	10 to 15	CO	None.
West Indian Creek	3,345	151 to 400	17.1 (10.6)	BRK	Excellent	5 to 10	CO	Manmade dam.
Trinchera Creek	2,941	151 to 400	14.5 (9.0)	BRK	Excellent	10 to 15	CO	None.
Polvadera Creek	2,045	151 to 400	12.1 (7.5)	None	Poor	< 5	NM	Waterfall.
Jacks Creek	1,504	151 to 400	11.3 (7.0)	None	Good	5 to 10	NM	Temporary/Manmade.
Jim Creek	1,283	151 to 400	10.0 (6.2)	BRK	Poor	5 to 10	CO	None.
Ute Creek	1,260	50 to 150	13.8 (8.6)	None	Good	5 to 10	NM	None.
Rio de Truchas	692	50 to 150	10.5 (6.5)	None	Fair	5 to 10	NM	Diversion.
Little Vermejo Creek	680	50 to 150	11.9 (7.4)	BRK	Excellent	5 to 10	NM	Temporary/Manmade.
Vallejos Creek	678	50 to 150	11.7 (7.3)	BRN	Good	10 to 15	CO	None.
Cave Creek	411	50 to 150	10.1 (6.3)	BRK, BRN, WS.	Fair	5 to 10	CO	None.
East Pass Creek	369	50 to 150	11.1 (6.9)	None	Fair	< 5	CO	Drying.
Middle Carnero Creek	344	< 50	11.3 (7.0)	WS	Fair	< 5	CO	Manmade dam.
Ricardo Creek	271	50 to 150	14.5 (9.0)	BRK	Good	5 to 10	CO	Temporary/Manmade.
Torsido Creek	250	50 to 150	10.3 (6.4)	BRK	Poor	< 5	CO	None.
Wagon Creek	246	151 to 500	20.9 (13.0)	BRK	Good	5 to 10	CO	Partial/Diversion.
McCrystal Creek	236	< 50	15.1 (9.4)	None	Good	5 to 10	NM	Temporary.
South Ponil Creek	202	< 50	15.3 (9.5)	None	Good	5 to 10	NM	Temporary/Manmade.
Rio de Oso	194	< 50	12.4 (7.7)	None	Fair	< 5	NM	None.
Capulin Creek	186	< 50	11.9 (7.4)	None	Excellent	5 to 10	NM	Drying.
North Fork Carnero Creek.	97	< 50	13.0 (8.1)	WS	Fair	< 5	CO	Manmade dam.
Cat Creek	Unknown	Unknown	15.1 (9.4)	None	Fair	< 5	CO	Drying.

Habitat fragmentation is a threat that can be partially alleviated by management activities. Three major watershed-scale projects have been initiated on both private and USFS lands and are in various phases of implementation. A joint project between Vermejo Park Ranch and the states of Colorado and New Mexico to restore the Costilla Creek watershed began in 2002 (Patten *et al.* 2007, pp 95–102). The restoration removed brook trout, brown trout, and introgressed cutthroat trout and reintroduced Rio Grande cutthroat trout into Costilla Creek, 2 tributaries, and 3 small lakes, totaling 22 km (13.6 miles) of stream and 9.5 ha (23.5 ac) of lake (project is discussed further in the ‘‘Fisheries Management’’ section below). As part of the larger Costilla Project, 34 km (21.1 mi) of Comanche Creek and selected tributaries were chemically treated with piscicides (chemicals that kill fish) in 2007. Most likely a second treatment will be required and will be completed in 2008 before Rio Grande cutthroat trout are stocked back into the watershed. A draft Candidate Conservation Agreement with Assurances with private landowners has been drafted so that the Costilla Creek project can be extended downstream. Successful implementation of this project would lead to the restoration of approximately 241 km (150 mi) and 25 lakes (Patten and Sloane 2007, p. 7). The Placer watershed in Colorado also underwent chemical treatment in 2007. This watershed has the potential for approximately 80.5 km (50 mi) of connected stream. If successful, the Costilla and Placer watersheds would represent substantial gains in the goal of creating connected stream systems for Rio Grande cutthroat trout.

While watershed restoration can reconnect streams and is the best method for addressing fragmentation, major restoration projects face many challenges including: negative public sentiment towards using piscicides in streams which slows or stops projects (Patten *et al.* 2007, p. 102), incomplete treatment which leaves nonnatives present, sabatoge of the treatment area (unauthorized introduction of nonnative trout) (Japhet *et al.* 2007, p. 17), subsequent barrier failure which allows nonnatives to reinvade a system (Japhet *et al.* 2007, p. 15), and inadvertent mistakes. While many stream segments have been restored and the Costilla and Placer watershed projects are in progress, no major watershed restorations have been completed.

The Service has evaluated the data presented by Alves *et al.* (2007) and supplemental information requested related to the database. Based on our knowledge of Rio Grande cutthroat trout populations that we previously classified as secure in 2002, and all of the information available to us we conclude:

(1) The majority of Rio Grande cutthroat trout populations (93 percent) are in isolated fragments less than 8 km (5 mi) long (71 percent);

(2) Populations are concentrated in high elevation (2,438 to 3,048 m (8,000 to 10,000 ft)) headwater streams that provide marginal habitat, especially in regards to the number and depth of pools critical for trout survival in times of environmental extremes;

(3) The drought in the early 2000s had resulted in adverse effects on several populations (discussed in more detail in the ‘‘Climate Change’’ section below);

(4) Eight of 13 populations we had identified as secure in 2002 would no

longer meet the criteria we used at that time (67 FR 39937); and

(5) Only eight populations currently meet our revised criteria for long-term persistence.

Although additional populations may have greater than 2,500 fish or are in streams longer than 9.6 km (6 mi), there are additional significant threats to those populations that put their long-term persistence in question. For these reasons, we find that Rio Grande cutthroat trout is threatened by fragmentation, isolation, and loss of habitat throughout its range. While watershed restoration may alleviate this threat in the future, insufficient progress has been made to alleviate the threat of fragmentation range-wide at this time.

Habitat Condition

Many Rio Grande cutthroat trout conservation populations currently occupy lands administered by Federal agencies. Of the total 1,110 km (690 mi) of occupied habitat, 698 km (434 mi) (63 percent) are under Federal jurisdiction, with the majority (59 percent) occurring within National Forests (Alves *et al.* 2007). Rio Grande cutthroat trout occupy 6.1 km (3.8 mi) of land administered by the BLM, 30.5 km (19 mi) managed by the National Park Service, and 397 km (247 mi) that are owned privately.

Land uses associated with each conservation population were identified in Alves *et al.* (2007, p. 49, Table 33), but the impact of the activities was not evaluated in relation to individual populations or the conservation of the subspecies. Non-angling recreation (e.g., camping, hiking, ATV use, etc.) occurs in 90 percent of the conservation populations, and angling occurs in 84 percent of the conservation populations. Livestock grazing occurs within the zone of influence (area around the stream in which activities influence stream habitat) of 87 percent of the conservation populations, roads in 58 percent, timber harvest in 19 percent, dewatering in 17 percent, and mining in 3 percent. Only 3 populations (3 percent) were judged as having no land use activities within a zone that would influence the stream habitat. Many populations have more than one land use occurring in the area.

An evaluation of habitat quality was conducted for currently occupied habitat (Alves *et al.* 2007, p. 20). The evaluation considered both natural habitat features and human disturbances, including land use practices. A stream ranked excellent if it had ample pool habitat, low sediment levels, optimal temperatures, and quality riparian habitat. Good habitat quality had some attributes that are less than ideal, and fair habitat has a greater number of attributes that are less than ideal. Poor habitat quality is found where most habitat attributes reflect inferior conditions. Approximately 224 km (139 mi) (20.2 percent of occupied habitat) received an excellent habitat rating. Good habitat conditions were found in 426 km (265 mi) of habitat (38.4 percent of occupied habitat), and fair habitat conditions were found in 335 km (208 mi) of habitat (30.1 percent of occupied habitat). Poor conditions were found in 35 km (22 mi) (3.2 percent of occupied habitat), and habitat conditions in 90 km (56 mi) (8.1 percent) were unknown (Alves 2007, p. 2). The majority of occupied habitat (58.6 percent) is considered in good or excellent condition (Alves *et al.* 2007, p. 20).

The Service also reviewed 19 detailed stream survey reports which were conducted by the Santa Fe and Carson national forests in the period 2001–2006. Although these surveys represent only about one quarter of the conservation populations in New Mexico (19 of 84 populations), both large (i.e., Pecos River, Rio de las Vacas, Comanche Creek) and small (i.e., Yerba, Manzanita creeks) streams are represented. Therefore, these surveys provide additional insight into the habitat condition on USFS lands. Of the 19 streams surveyed, the most consistent problem is lack of pool habitat. Of the 19 streams, 18 had less than the 30 percent pool habitat (range 1–21 percent) needed to be considered properly functioning trout streams. For eight of these streams, a target value of 30 percent pool habitat was not considered appropriate because they were 1st or 2nd order streams (i.e., headwater streams) which often have few pools naturally because they occur on high gradient slopes. But for four of these eight streams, the pool habitat ranged from 1–3 percent and the reports noted that even for headwater streams this was an insufficient number of pools.

In most streams (16 of 19) the average residual pool volume, which represents initial pool depth if the stream were to dry, met the USFS standard of 0.3 m (1 ft) or greater. However, the deepest average residual pool volume was only 0.67 m (2.2 ft) and the mean depth of pools for all 19 streams was 0.39 m (1.3 ft), indicating that the majority of pools are relatively shallow.

Pools are recognized as important overwintering habitat and also are holding areas for trout when streams dry. Not only are the number of pools consistently fewer than desirable, but they are also relatively shallow, and thus provide limited refugial habitat in times of stream freezing or drying. Lack of deep pools could affect year-class survival. As noted by Cowley (2007 DOI: 10.1002/acq.845) loss of a year class of fish would suggest that longer stream length is needed to provide adequate habitat for long-term population persistence. However, as mentioned above, the sample size (19 streams) is relatively small and it is not known if the results accurately represent Rio Grande cutthroat trout streams range-wide.

Livestock grazing occurs in the vicinity of 87 percent of the Rio Grande cutthroat trout populations (Alves 2007, p. 49). We recognize that improper grazing does cause adverse impacts (e.g., loss of cover, increased sedimentation, loss of riparian vegetation) to some individual populations of Rio Grande cutthroat trout, especially during drought conditions when the cattle tend to concentrate in riparian areas. While a few of the USFS stream surveys noted that impacts by cattle (or elk) were causing localized problems, grazing was not cited as causing damage throughout the length of any stream. Specific information on grazing impacts to Rio Grande cutthroat trout habitat on a range-wide basis is not available. We have no information that leads us to conclude that improper grazing is a significant threat to Rio Grande cutthroat trout range-wide.

Timber harvest and associated road building has also led to the deterioration of Rio Grande cutthroat trout habitat. However, timber harvest in the National Forests has declined appreciably in the last 20 years. As an example, on the two forests in New Mexico that have conservation populations, the Santa Fe National Forest and Carson National Forest, there has been a total of 3.2 ha (8 ac) clear cut since 1995 (Fink 2008 pp. 2, 3). The average amount of timber cut per year from 1984 to 1994 in these forests was 27.6 and 19 million board feet (MBF), respectively. From 1995 to 2005, the average amount cut per year was 3.5 and 0.09 MBF, respectively (Fink 2008, pp. 2, 3). While the effects of past logging practices may still be evident on the landscape in some locations, we conclude that timber harvest is not currently a threat to Rio Grande cutthroat trout populations.

Roads and off-road vehicles can have negative impacts on stream habitat primarily through increased sedimentation which degrades spawning habitat. Non-angling recreation (which includes hiking and camping as well as off-road vehicle use) is present near 90 percent of the conservation populations. On November 9, 2005, the USFS published revised rules regarding travel management on their lands (70 FR 68264). One of the primary purposes of the rule is to protect natural resources. The final rule requires the designation of roads, trails, and areas that are open to motor vehicle use by class of vehicle and, if appropriate, time of year. Use of motor vehicles off designated routes will be prohibited (70 FR 68264). The Service has begun consultation on the Travel Management Plans proposed by National Forests in USFS Region 3 (Arizona and New Mexico) and protecting aquatic resources is an important component of these plans. While roads have been identified as an area of concern for some streams (e.g., Tio Grande, Rio Grande del Rancho, Martinez 2001, 2002), we conclude that roads are not a threat to Rio Grande cutthroat trout populations range-wide.

Management agencies are actively working towards improving habitat conditions for Rio Grande cutthroat trout. In addition to the travel management rule on USFS lands, several projects have been completed recently to address habitat degradation caused by roads. For example, grant money was obtained and used to inventory and identify 97 road improvement projects to reduce sediment input into Comanche Creek (Martinez 2006, p. 5). Six culverts were installed or realigned and ten sediment traps and energy dissipaters were installed below culvert spillways. Culverts that drained directly into Comanche Creek were removed. Abandoned logging roads were stabilized and unneeded roads were re-contoured to natural slope and re-vegetated (USFS 2006, pp.18–19). In 2006, on the Santa Fe National Forest, over 1,829 m (6,000 ft) of buck and pole fence was constructed to improve traffic control and enforce an off-road vehicle closure around Rio Cebolla. Approximately 17.7 km (11 mi) of stream and riparian habitat was protected by this project (USFS 2006, p. 12). On the Rio Grande National Forest, road-stream crossing inventories and assessments were conducted for all streams with conservation populations to determine if the culverts were barriers to fish (USFS 2006, p. 4). Most of the 120 conservation populations (90 percent) have one or more restoration, conservation, or management activities either completed or currently being implemented (Alves *et al.* 2007, p. 60).

Range-wide habitat quality is still difficult to accurately assess. Although an insufficient amount of pool habitat exists on the majority of streams sampled by the USFS in New Mexico, we cannot draw the same conclusion range-wide at this time because of lack of data. Alves *et al.* (2007 database) did not identify a lack of pools as a systematic problem. While land management practices have clearly improved and have less direct impact on Rio Grande cutthroat trout streams, some streams are still recovering from past land management practices. Therefore we conclude that there is insufficient information to indicate that habitat quality currently is a significant threat to Rio Grande cutthroat trout rangewide.

Nonnative Species

The introduction of nonnative trout is widely recognized as one of the leading causes of range reduction in cutthroat trout subspecies (Griffith 1988, pp. 134, 137; Lassuy 1995, p. 394; Henderson *et al.* 2000, pp. 584, 585; Dunham *et al.* 2002, p. 374; Peterson *et al.* 2004, p. 769). Dunham *et al.* (2004) provide an overview of the impact of nonnatives on headwater systems in North America. Since the late 1800s, fishery managers introduced nonnative salmonids (trout and salmon species) into lake and stream habitats of Rio Grande cutthroat trout. Nonnative rainbow, brook, brown trout and Yellowstone cutthroat trout have been introduced extensively throughout the range of Rio Grande cutthroat trout, and they compete (brook and brown trout) and hybridize (rainbow and other cutthroat subspecies) with Rio Grande cutthroat trout. Forty-six of 120 conservation populations (38 percent) have nonnative trout present (2007 database). When Rio Grande cutthroat trout occur in the same stream as nonnative trout, Rio Grande cutthroat trout typically occupy the colder, headwater reaches and the nonnative trout occupy areas downstream (Griffith 1988, p. 135; Dunham *et al.* 1999, p. 885).

Competition from nonnative trout, especially brook trout, is recognized as a threat to Rio Grande cutthroat trout (Behnke 2002, p. 147; Peterson *et al.* 2004, pp. 768, 769). When brook trout invade streams occupied by cutthroat trout, the native cutthroat trout decline or are displaced (Griffith 1988, p. 136; Harig *et al.* 2000, pp. 994, 998, 999; Dunham *et al.* 2002, p. 378; Peterson *et al.* 2004, p. 769; Young and Guenther-Gloss 2004, p. 193; Fausch *et al.* 2006, p. 6). Brook trout are the most common nonnative trout sympatric (co-occurring) with Rio Grande cutthroat trout populations in Colorado (2007 database). Brook trout reduce recruitment of cutthroat trout and reduce inter-annual survival of juveniles, leading to a reduction in population size (Peterson *et al.* 2004, p. 769). Experiments where brook trout were removed from cutthroat trout populations showed an increase in the survival of juvenile cutthroat trout (Peterson *et al.* 2004, p. 767). Paroz (2005, p. 22) found that mean density and relative weight of Rio Grande cutthroat trout were lower in populations sympatric with brook trout. Several Rio Grande cutthroat trout conservation populations have been identified as at risk and declining because of brook trout (Alves *et al.* 2002, pp. 1–4).

In New Mexico, brown trout is the most common nonnative trout present in Rio Grande cutthroat trout conservation populations (summarized from 2007 database). Not only are brown trout piscivores (feed on other fish), but they have also been shown to compete with Rio Grande cutthroat trout for resources such as food and space. Research has shown that Rio Grande cutthroat trout confined with brown trout grew significantly less, while the brown trout grew significantly more, than control fish (Shemai *et al.* 2007, pp. 315, 320, 321). A similar result was seen in experiments conducted with Bonneville cutthroat trout and brown trout (McHugh and Budy 2005, p. 2788). These results indicate that brown trout represent a threat to Rio Grande cutthroat trout from competition as well as predation (Paroz 2005, p. 34).

The primary threat to Rio Grande cutthroat trout from rainbow trout and other cutthroat trout subspecies is through hybridization and introgression (Rhymer and Simberloff 1996, pp. 83, 97). The genetic distinctiveness of Rio Grande cutthroat trout can be lost through hybridization (Allendorf *et al.* 2004, p. 1205). Of the 120 conservation populations, 95 (79 percent) range-wide have been tested and are less than 1 percent introgressed (Alves *et al.* 2007, p. 31). These nonintrogressed populations occupy 870 km (541 mi), or 78 percent, of the 1110 km (690 mi) occupied by conservation populations (Alves *et al.* 2007, p. 31). Another 161 km (100 mi) are occupied by populations that are 90–99 percent genetically pure, and 104 km (65 mi) are occupied by populations that have not been tested but are connected to nonintrogressed populations and have no record of stocking (Alves *et al.* 2007, p. 34).

To minimize the contact of nonnative trout with Rio Grande cutthroat trout, barriers have been constructed where natural barriers didn't already exist in order to prevent nonnatives from invading. Alves *et al.* (2007, pp. 35, 36) rated the genetic risk to the 120 conservation populations. A combination of barrier condition or presence and distance to hybridizing species, determined if a population was at moderate or low risk (Alves *et al.* 2007, p. 80). Populations protected by a complete barrier fell into the no risk category. They determined that 80 had no risk of genetic mixing with nonnative trout, 32 were at moderate risk, and 4 were at low risk. As mentioned earlier, four populations that Alves *et al.* (2007, pp. 35, 36) consider conservation populations are sympatric with a hybridizing species, and, therefore, we consider them at high risk.

Since 2002, NMDGF and CDOW visited approximately 40 and 50 Rio Grande cutthroat trout conservation populations, respectively, to assess barrier presence and condition. Seven new barriers have been installed since 2002, and maintenance was done on at least eight (Japhet *et al.* 2007, pp. 24, 25; Patten *et al.* 2007, pp. 6, 11, 12, 16, 17, 53). Both agencies have also mechanically and chemically removed nonnative trout from Rio Grande cutthroat trout streams. NMDGF removed nonnatives from 11 streams, and CDOW removed them from two (Patten and Sloane 2007, p. 5; Japhet *et al.* 2007, p. 26).

Since 2002, CDOW and NMDGF have also proactively pursued genetic testing of Rio Grande cutthroat trout populations using the best technologies available. In many instances, the results confirmed previous assessments of genetic purity, while in other cases populations were either upgraded or downgraded (Japhet *et al.* 2007, pp. 46–47; Patten *et al.* 2007, pp. 43–45). Diagnostic markers for Yellowstone cutthroat trout were also identified, which has led to more refined testing and more confidence in the categorization of the populations. The most recent results were used in the 2007 database. Results of the testing can be found in peer-reviewed literature (e.g., Pritchard *et al.* 2007a, Pritchard *et al.* 2007b) and in reports to the States (e.g., Pritchard and Cowley 2005).

Approximately 38 percent of Rio Grande cutthroat trout conservation populations co-occur with nonnative trout (2007 database). Competition, predation, and hybridization with nonnative trout are considered an important source of stress that can depress Rio Grande cutthroat trout population numbers or, under the right circumstances, displace them (Fausch *et al.* 2006, pp. 9, 10). Although resource agencies remove nonnative trout through electrofishing when they co-occur with cutthroat trout subspecies, seldom if ever is complete removal possible (Patten *et al.* 2007, p. 104). Peterson *et al.* (2004, p. 769) show that over 90 percent of the brook trout population must be removed each year for 3 consecutive years to allow a large cohort of Colorado River cutthroat trout to survive from age 0 to age 2. This level of effort has not been documented for stream segments occupied by Rio Grande cutthroat trout populations (e.g., Japhet *et al.* 2007, p. 26).

The Service concludes that nonnative fish are a threat to Rio Grande cutthroat trout range-wide based on the following facts:

(1) Approximately 38 percent of the conservation populations have nonnative trout present;

(2) Nonnative fish are a documented threat to Rio Grande cutthroat trout populations;

(3) Mechanical removal cannot remove all of the nonnative fish;

(4) The level of effort required to reduce brook trout populations to levels sufficient for survival of young Rio Grande cutthroat trout is not currently being conducted; and,

(5) The number of streams that need regular treatment exceeds the capability of resource managers at their current staffing levels.

Drought

The relatively short-term drought of the early 2000s negatively impacted or extirpated 14 Rio Grande cutthroat trout populations in Colorado and New Mexico (Japhet *et al.* 2007, pp. 42–44; Patten *et al.* 2007, pp. 14–40). A fifteenth population is thought to have been extirpated in 2006 by complete freezing caused by low flow in the winter (Ferrell 2006, p. 11). The number of streams impacted may have been greater, because managers only survey a fraction of the 120 conservation populations in any given year.

We assume that small streams (1.5 m (5 ft) wide or less) are more susceptible to drying, increased water temperatures, and freezing than larger ones and that stream width is an indicator of risk. Decreased stream flow reduces the amount of habitat available for aquatic species, and water quality (e.g., temperature, dissolved oxygen) may become unacceptable in declining flow. Approximately 27 conservation populations are in streams that are 1.5 m (5 ft) or less in width throughout their entire length (2007 database). An additional 29 stream segments that are tributaries to the conservation populations are also less than 1.5 m (5 feet) in width (2007 database). Although not all small streams have equal risk, small headwater streams, especially those with an inadequate number of deep pools, are most likely to lose suitable habitat. Even if streams do not dry (or freeze) completely, stream length can be truncated during drought and many fish can perish, greatly reducing the population number (bottleneck) and reducing genetic diversity (Frankham *et al.* 2002, p. 183).

Because of the documented extirpation and population reductions of Rio Grande cutthroat trout caused by drought, the possibility of more widespread drought accompanying climate change, and the lack of a range-wide plan to address drought, we conclude that drought is a threat to Rio Grande cutthroat trout throughout its range (discussed in ''Climate Change'' section below).

Fire

Wildfires are a natural disturbance in forested watersheds. However, since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average frequency during the period 1970–1986. The total area burned is more than six and a half times the previous level (Westerling *et al.* 2006, p. 941). In addition, the average length of the fire season during 1987–2003 was 78 days longer compared to that during 1970–1986 and the average time between fire discovery and control was 29.6 days longer (Westerling *et al.* 2006, p. 941). Westerling *et al.* (2006, p. 942) found that wildfire sensitivity was related to snowmelt timing with 56 percent of fires and 72 percent of burned area occurring in early snowmelt years. Early spring snowmelt is strongly associated with spring temperature (Stewart *et al.* 2004, p. 218; Westerling *et al.* 2006, p. 942). Westerling *et al.* (2006, p. 942) conclude that there are robust statistical associations between wildfire and climate in western forests and that increased fire activity over recent decades reflects responses to climate change (discussed further in the ''Climate Change'' section below).

In the Southwest, the fire season is followed by the monsoon season (July to August). Consequently, denuded watersheds are susceptible to heavy precipitation leading to severe floods and ash flows. Although fish may survive the fire, ash and debris flows that occur after a fire can eliminate populations of fish from a stream (Rinne 1996, p. 654; Brown *et al.* 2001, p. 142; USFS 2006, p. 32; Patten *et al.* 2007, p. 33), and the fire suppression activities (e.g., fire retardant, water removal, road construction) may also impact stream ecosystems (Buhl and Hamilton 2000, pp. 410–416; Backer *et al.* 2004, pp. 942, 943). Wildfires within the range of Rio Grande cutthroat trout have impacted or eliminated fish populations (Japhet *et al.* 2007, p. 20; Ferrell 2006, p. 32; Patten *et al.* 2007, pp. 33, 36), and the effects of large fires are recognized as a threat to greenback cutthroat (*Oncorhynchus clarki stomias*) populations in Colorado (Young and Guenther-Gloss 2004, p. 194). Imperiled fish populations can be rescued if ash flows are imminent, but a rescue and evacuation plan should be in place (e.g., Brooks 2004, pp. 1–15).

Dunham *et al.* (2007, p. 342) found significantly elevated stream temperatures for at least a decade after a stand-replacing wildfire because of the lack of stream shading. In addition, the authors suggest that longer term (over 20 years) increases in stream temperatures are likely in systems where debris flows or severe floods completely eliminate streamside vegetation and reorganize the channel. Rainbow trout were found to be resilient and recolonized the burned streams within 1 year of extirpation in spite of elevated water temperatures (Dunham *et al.* 2007, p. 343). Dunham *et al.* (2003a, pp. 188, 189) suggest that fire poses a greater threat to fish populations when habitat is fragmented. Moyle and Light (1996, p. 157) argue that habitat degradation favors nonnative fishes and that species with narrow habitat requirements are expected to be more sensitive to habitat alteration caused by fire than generalist species such as rainbow trout (Dunham *et al.* 2003a, p. 189).

Fire risk can be reduced through fuels reduction and prescribed burns. The National Forests in New Mexico have active programs to improve forest health. As an example, 28,314 ha (69,965 ac) have undergone fuel-reduction treatment, thereby improving watershed conditions associated with 100 km (62 miles) of stream, and an additional 58,912 ha (145,575 ac) are planned for treatment to improve conditions associated with an additional 128 km (79.5 mi) of stream (Ferrel 2002, p. 12). Such techniques have been found to reduce fire severity even under extreme weather conditions in low-elevation ponderosa pine forests (Schoennagel *et al.* 2004, p. 669). However, for mid-elevation, mixed-severity fire regimes, fuel-reduction treatments had virtually no effect on the 2002 Hayman Fire (Colorado), and extreme climate can override the influence of stand structure and fuels on fire behavior (Schoennagel *et al.* 2004, pp. 672, 673). Climate variation, not fuel levels, is seen as the dominant influence on fire frequency and severity in subalpine forests (Schoennagel *et al.* 2004, p. 666).

Wildfires that eliminate nonnative fish provide the opportunity to reclaim streams for Rio Grande cutthroat trout. The 1996 Dome Fire in the Jemez Mountains (Santa Fe National Forest) extirpated the fish residing in Capulin Canyon. In 2006, after 10 years of habitat recovery, 100 Rio Grande cutthroat trout from Canones Creek were stocked into Rio Capulin adding 11.2 km (7.0 mi) of occupied habitat in New Mexico (Patten *et al.* 2007, p. 94). In addition, ash flows after the 2004 Peppin Fire in the Capitan Wilderness (Lincoln National Forest) apparently eliminated all fish from Pine Lodge Creek and Copeland Creek (Patten *et al.* 2007, pp. 255–258), and there are plans to restore Rio Grande cutthroat trout into these streams. Restoration of Pine Lodge Creek would add approximately 4 km (2.5 mi) of habitat in the Pecos Headwaters GMU (Patten *et al.* 2007, p. 255).

Although we recognize that Rio Grande cutthroat trout evolved in a landscape that included fire, wildfire intensities and size are likely changing because of increased fuel loads and possibly climate change (see ‘‘Climate Change’’ section below). Wildfire today is much more of a threat than it was historically to Rio Grande cutthroat trout because of existing habitat loss, fragmentation, and climate change. These multiple stressors may overwhelm the subspecies' resilience to disturbance such as fire (Rieman *et al.* 2005, pp. 2, 3). Although fire may also provide opportunity for repatriation of Rio Grande cutthroat trout by eliminating nonnative fish, total elimination of nonnative fish from fire-affected streams is not guaranteed, and it may take many years for the habitat to become suitable. For these reasons, we conclude that wildfire is a significant threat to Rio Grande cutthroat trout throughout its range.

Summary of Factor A

In summary, Rio Grande cutthroat trout populations have been and continue to be impacted by habitat fragmentation and isolation, nonnative species interactions, drought, and fire. Rio Grande cutthroat trout conservation populations occupy a fraction of their historical habitat, they are confined primarily to small high-elevation streams with marginal habitat, they are highly fragmented, and the stream segments they occupy are short in length. All of these factors work to reduce gene flow between populations and reduce the ability of populations to recover from catastrophic events thus threatening their long-term persistence. Detailed habitat surveys, although not available range-wide, are uniformly consistent in documenting a lack of pools in streams occupied by Rio Grande cutthroat trout. Deep pools are considered a critically important element of Rio Grande cutthroat trout habitat. As discussed above, in order to ensure some level of population stability and contribute to the long-term persistence of the subspecies, populations should consist of more than 2,500 fish, occupy 9.6 km (6 mi) of stream or more, and have no nonnative trout present. Currently, only eight Rio Grande cutthroat trout populations meet these criteria. Nonnative trout co-occur with 38 percent of Rio Grande cutthroat trout conservation populations. Because of the documented negative impacts of nonnative trout on cutthroat trout discussed above, nonnatives are an ongoing threat to the security of Rio Grande cutthroat trout. Additionally, although drought and fire have impacted a limited number of populations since the last status review, negative impacts from these two factors may increase in response to climate change (as discussed in the ‘‘Climate Change’’ section below). Based on the best scientific and commercial information available to us, we conclude that the present or threatened destruction, modification, or curtailment of its habitat or range is a threat to the continued existence of Rio Grande cutthroat trout.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No commercial harvest occurs for Rio Grande cutthroat trout. Recreational angling occurs on approximately 84 percent of the populations (Alves *et al.* 2007, p. 49). Fishing regulations in New Mexico and Colorado appropriately manage recreational angling. For example, many of the streams with Rio Grande cutthroat trout are ‘‘catch and release.’’ Those that are not have a 2 (New Mexico) or 4 (Colorado) fish limit. Many of the streams with pure populations of Rio Grande cutthroat trout are remote and angling pressure is light. For these reasons, angling is not considered a threat to Rio Grande cutthroat trout.

Scientific collection of Rio Grande cutthroat trout for scientific or educational purposes is controlled by a strict permitting process that prevents excessive sampling. In addition, advancements in molecular technology have resulted in the need for only a small clipping from a fin to provide sufficient material to perform molecular analysis of genetic purity. To test for whirling disease (see ''Disease'' section below for further discussion), usually 60 fish are collected and sacrificed. However, to minimize the collection of Rio Grande cutthroat trout during whirling disease testing, nonnative trout are collected preferentially over Rio Grande cutthroat trout, or sample sites are selected below a barrier that protects a population of Rio Grande cutthroat trout from nonnative trout. In some situations fewer than 60 Rio Grande cutthroat trout will be collected and sacrificed for testing. For these reasons, overutilization for scientific purposes is not considered a threat to Rio Grande cutthroat trout.

Summary of Factor B

Because no commercial harvest occurs for Rio Grande cutthroat trout, fishing regulations in New Mexico and Colorado minimize the impact of recreational angling, and scientific collection of Rio Grande cutthroat trout for scientific or educational purposes is controlled by a strict permitting process that prevents excessive sampling, we conclude that the best scientific and commercial information available to us indicates that Rio Grande cutthroat trout is not threatened by overutilization for commercial, recreational, scientific, or educational purposes.

C. Disease or Predation

Disease

Whirling disease is of great concern to fishery managers in western States. Whirling disease is caused by the nonnative myxosporean parasite, *Myxobolus cerebralis.* This parasite was introduced to the United States from Europe in the 1950s and requires two separate hosts, a salmonid fish and an aquatic worm (*Tubifex tubifex*) to complete its life cycle. Spores of the parasite are released from infected fish when they die. The spores are ingested by *T. tubifix* where they undergo transformation in the gut to produce actinosporean triactionomyxons (TAMs). Trout are infected either by eating the worms (and TAMs) or through contact with water in which TAMs are present.

The myxosporean parasite became widely distributed in Colorado in the early 1990s through the stocking of millions of catchable size trout from infected hatcheries (Nehring 2007, p. 1). Up to 2001, it was estimated that whirling disease infection had negatively impacted recruitment of wild rainbow and brook trout fry (small recently emerged fish) in 560–600 km (350–400 mi) of stream in Colorado (Nehring 2007, p. 2). In 2006, the number of sites that tested positive for whirling disease was considerably higher than in any of the previous field seasons (Nehring 2007, p. 11). Whirling disease is also present in several streams in New Mexico (67 FR 39943, Patten and Sloane 2007, p. 11). Laboratory (DuBey *et al.* 2007, pp. 1411, 1412) and field (Thompson 1999, pp. 323–325) experiments have shown that Rio Grande cutthroat trout is very susceptible to whirling disease.

Among the four lineages (I, III, V, and VI) of *T. tubifix* known to occur in Colorado, New Mexico, and other states, lineage III is the only one susceptible to infection by *M. cerebralis* (DuBey and Caldwell 2004, p. 183; Nehring 2007, p. 11). Because *T. tubifix* is typically found in degraded habitat with higher levels of sediment and warmer temperatures, it had been hypothesized that Rio Grande cutthroat trout were provided some level of protection because they occur in high-elevation cold-water streams (67 FR 39943). Extensive sampling of tubificid worms in Colorado does not support this hypothesis. Nehring (2007) collected tubificid worm samples from over 100 sites in Colorado, including streams occupied by Rio Grande cutthroat trout. He stratified his results by 305 m (1,000 ft) elevation groups from 1829 m (6,000 ft) to 3657 m (12,000 ft) (e.g. 1829–2134 m (6,000–7000 ft), 2134–2438 m (7001–8,000 ft), etc.). Lineage III worms had the greatest abundance, outnumbering all of the other lineages combined, at all elevations. The number of sites with lineage III worms was approximately the same at all elevations from the 1829–2134 m (6,000–7,000 ft) band up to the 3048–3353 m (10,000–11,000 ft) band (Nehring 2007, p. 10) indicating that the high-elevation cold-water streams do not provide protection from lineage III worms.

One hundred and five conservation populations (88 percent) are judged to have very limited risk from whirling disease or other potential diseases because the pathogens are not known to exist in the watershed or a barrier blocks upstream fish movement (Alves *et al.* 2007, p. 38). Six populations are at minimal risk because they are greater than 10 km (6.2 mi) from the pathogen or they are protected by a barrier, but the barrier may be at risk of failure (Alves *et al.* 2007, p. 38). Eight populations were identified as being at moderate risk because whirling disease had been identified within 10 km of occupied habitat (Alves *et al.* 2007, p. 38). In 2006, it was discovered that whirling disease had infected brook trout and Rio Grande cutthroat trout in Placer Creek, Colorado, a conservation population, and in 2007 it was chemically treated to remove infected fish and nonnative brook trout.

In 2002, the Pecos, Cebolla, San Juan, Cimarron, Red, and Canones rivers in New Mexico were listed as being infected with whirling disease (67 FR 39943). By 2007, more than 80 streams and lakes had been tested for the disease (Patten and Sloane 2007, pp. 10–13). North Bonito Creek, Brazos River, and Los Pinos River were added to the list of streams testing positive for whirling disease. Canones and Jacks creeks, which had tested positive in 2000, tested negative in 2005, and 2003, respectively (Patten and Sloane 2007, pp. 10–13). Of the streams listed, Rio Cebolla, Pecos River and Cimarron River are occupied by Rio Grande cutthroat trout upstream above barriers.

NMDGF policies and regulations prohibit the stocking of any whirling disease positive fish in the State of New Mexico (Patten and Sloane 2007, p. 10). All private facilities must maintain a pathogen-free certification. The Seven Springs Hatchery, which is used for Rio Grande cutthroat trout broodstock, has tested negative on all occasions since it was refurbished (Patten and Sloane 2007, p. 10). In Colorado stocking of whirling disease positive fish in protected habitats, which include native cutthroat trout waters, is prohibited (Japhet *et al.* 2007, p. 12). Colorado and New Mexico have web sites, brochures, and information in their fishing regulations regarding whirling disease and what anglers can do to prevent its spread. In addition, both States have regulations regarding the stocking of fish by private landowners that are designed to eliminate the importation of whirling disease positive fish. It states clearly in the fishing regulations that it is illegal to stock fish in public waters without prior permission from a State agency.

Whirling disease remains a concern for Rio Grande cutthroat trout populations. One Rio Grande cutthroat trout conservation population was infected in Colorado, and restoration efforts were immediately implemented to address the issue. Although widespread increases in *M. cerebralis* have not been seen, additional infected sites have been documented. Because of the limited level of infection currently, whirling disease is not seen as a significant threat to populations range-wide. However, climate change and warmer stream temperature may facilitate the spread of whirling disease in the future (discussed in the ''Disease'' section in Factor E below).

Predation

Brown trout are piscivores and are the most likely predator on Rio Grande cutthroat trout. Additionally, brown trout have been found to have a significant negative impact on the condition of coexisting Rio Grande cutthroat trout through harassment (e.g., chasing) (Shemai 2004, pp. 315–323; McHugh and Budy 2005, p. 2788). It is probable that larger brown trout prey on young Rio Grande cutthroat trout and, unchecked, brown trout can depress population levels. Warmer water temperatures in the future may give brown trout a greater competitive advantage over Rio Grande cutthroat trout (discussed in the ''Climate Change'' section below). However, we have insufficient information at this time to conclude that predation by brown trout is currently a significant threat to Rio Grande cutthroat trout.

Summary of Factor C

One population of Rio Grande cutthroat trout has been infected with whirling disease since our 2002 status review and eight conservation populations are considered to be at moderate risk of infection. Although whirling disease is currently limited in distribution and effect, it has the potential to become a more widespread problem due to warmer waters that could result from climate change (discussed in the ''Climate Change'' section below). We have insufficient information to conclude that predation is a significant threat at this time. Therefore, we conclude that the best scientific and commercial information available to us indicates that, although the status of Rio Grande cutthroat trout has not yet been affected by disease, Rio Grande cutthroat trout is likely to be threatened by disease in the foreseeable future.

D. The Inadequacy of Existing Regulatory Mechanisms

The NMDGF and the CDOW have authority and responsibility for the management of Rio Grande cutthroat trout. Rio Grande cutthroat trout is designated as a species of special concern by the State of Colorado and of special management concern by the State of New Mexcio. The agencies' capabilities include the regulation of fishing, law enforcement, research, and conservation and educational activities relating to Rio Grande cutthroat trout. Policies regarding the stocking of nonnative fish (no nonnatives are stocked in Rio Grande cutthroat trout populations), minimization of exposure to whirling disease and other diseases, and broodstock management are in place in both States. In 2004, the ''Conservation Plan for Rio Grande Cutthroat trout in Colorado'' was approved by the Director of CDOW. The goal of the plan is to assure the long-term persistence of Rio Grande cutthroat trout throughout its historic range by preserving genetic integrity, reducing population fragmentation, and providing suitable habitat to support self-sustaining populations (Japhet *et al.* 2007, p. ii). New Mexico (2002) has an approved management plan currently being implemented that will ''facilitate long range cooperative, interagency conservation of Rio Grande cutthroat trout.''

Rio Grande cutthroat trout populations have been lost because of stream drying (Japhet *et al.* 2007 pp. 42–44), and other trout populations in the Southwest have been extirpated as the result of ash flows following fire (Brown *et al.* 2001 p. 142). Imperiled fish populations can be rescued from streams (Brooks 2004, pp. 1–15; Japhet *et al.* 2007, p. 20). In the face of widespread drought or fire (discussed in the ''Climate Change'' section below) it is expected that many streams would be affected at one time, as seen in the 2002 drought (Japhet *et al.* 2007, pp. 42–44; Patten *et al.* 2007, pp. 14–40). An emergency rescue and evacuation plan is not in place for Rio Grande cutthroat trout, nor do we anticipate that this strategy would be effective in eliminating the threat of stream drying or post-fire ash flows in the face of widespread drought.

In 2003, a range-wide conservation agreement was signed by CDOW, NMDGF, USFS, the Service, BLM, NPS, and Jicarilla Apache Nation. The purpose of the agreement is to facilitate cooperation and coordination among State, Federal, and tribal agencies in the conservation of Rio Grande cutthroat trout. The Conservation Team has met several times and the ''Range-wide Status of Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*): 2007'' is a product of the team's cooperative effort.

Regulatory Mechanisms Involving Land Management

Numerous State and Federal laws and regulations help to minimize adverse effects of land management activities on Rio Grande cutthroat trout. Federal laws that protect Rio Grande cutthroat trout and their habitats include the Clean Water Act (33 U.S.C. 1251 *et seq.*), Federal Land Policy and Management Act (43 U.S.C. 1701 *et seq.*), National Forest Management Act (16 U.S.C. 1600 *et seq.*), Wild and Scenic Rivers Act (16 U.S.C. 1271 *et seq.*), Wilderness Act (16 U.S.C. 1131 *et seq.*), and the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*). Approximately 59 percent of Rio Grande cutthroat trout habitat occurs on lands managed by Federal agencies. The majority of those lands are managed by the USFS. Rio Grande cutthroat trout occur over a large geographic area within the Rio Grande, Santa Fe, and Carson National Forests in Colorado and New Mexico. Rio Grande cutthroat trout is designated as a sensitive species on all USFS lands.

The Regional Forester's Sensitive Species List policy is applied to projects implemented under the 1982 National Forest Management Act Planning Rule. However, in 2005, USFS implemented a new planning rule (70 FR 1023, January 5, 2005), which directs land management plans to be more strategic and less prescriptive. Under the new rule, land management plans identify ecosystem-level desired conditions and provide management objectives and guidelines to move toward the desired conditions. The land management plans also will provide species-specific direction for special status species when the broader ecosystem-level desired conditions do not provide for their needs. However, the United States District Court in *Citizens for Better Forestry et al.* v. *U.S. Department of Agriculture* (N.D. Calif.) enjoined the Forest Service from implementation and utilization of the National Forest land management planning rule published on January 5, 2005 (70 FR 1023). Currently, the U.S. Department of Agriculture Office of General Counsel is reviewing this matter and will provide legal advice to USFS on how to proceed with forest planning. Therefore, efforts specific to forest planning are postponed until further direction is available (USFS 2008).

Threats to depletion of stream flow can be reduced by the U.S. Forest Service utilizing its authorities, if any, to further secure additional instream flows in Colorado. Rio Grande cutthroat trout conservation populations are protected by State instream flow water rights or USFS Reserve water rights along 620 km (385 mi) in 63 stream segments (approximately 70 percent of occupied habitat) within the Rio Grande basin in Colorado. Most of the remaining Rio Grande cutthroat trout conservation populations that are not associated with instream flow water rights are found on private property within the boundaries of the old Spanish Land Grants where natural resource stewardship is practiced. Regulatory controls of water quality in Colorado are implemented by the

Colorado Water Quality Control Division and Commission. Water quality standards are in place to protect the maintenance of aquatic life in coldwater environments, and special resource restrictions are also available to provide further site-specific protection to water quality (Japhet *et al.* 2007, p. 18).

Summary of Factor D

The NMDGFG, CDOW and USFS are actively managing Rio Grande cutthroat trout and its habitat. They also have authority for and are undertaking fisheries management, research, educational and law enforcement activities designed to improve the conservation status of the species. There is a range-wide conservation agreement that also involves the Service and other parties. Existing regulations, authorities, and policies address current threats to the species that are subject to regulatory control. However, climate change will have potential impact throughout the range of this species. At this time it is difficult to state how these effects will be addressed through existing regulatory mechanisms.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Climate Change

In this section, we discuss the aspects of climate change that will most likely affect the habitat of Rio Grande cutthroat trout. We begin by presenting the evidence that indicates that climate change is occurring globally. We then discuss literature related to climate change that has been published for the Southwest and southern Rocky Mountains that documents changes either that have already occurred or that researchers predict will occur. Finally, we present data that have been collected for streams occupied by Rio Grande cutthroat trout that indicate that the effects of climate change could exacerbate the threats discussed above.

The Intergovernmental Panel on Climate Change (IPCC) is a scientific body set up by the World Meteorological Organization and the United Nations Environment Program in 1988. It was established because policymakers needed an objective source of information about the causes of climate change, its potential environmental and socio-economic consequences, and the adaptation and mitigation options to respond to it. The Service considers the IPCC an impartial and legitimate source of information on climate change. In 2007, the IPCC published its Fourth Assessment Report, which is considered the most comprehensive compendium of information on actual and projected global climate change currently available.

Although the extent of warming likely to occur is not known with certainty at this time, the IPCC (2007a, p. 5) has concluded that warming of the climate is unequivocal and continued greenhouse gas emissions at or above current rates would cause further warming (IPCC 2007a, p. 13). The IPCC also projects that there will very likely be an increase in the frequency of hot extremes, heat waves, and heavy precipitation (IPCC 2007a, p. 15). Warming in the Southwest is expected to be greatest in the summer (IPCC 2007b, p. 887). Annual mean precipitation is likely to decrease in the Southwest and the length of snow season and snow depth are very likely to decrease (IPCC 2007b, p. 887). Most models project a widespread decrease in snow depth in the Rocky Mountains and earlier snowmelt (IPCC 2007b, p. 891).

In consultation with leading scientists from the Southwest, the New Mexico Office of the State Engineer prepared a report for the Governor (State of New Mexico 2006) which made the following observations about the impact of climate change in New Mexico:

(1) Warming trends in the American Southwest exceed global averages by about percent (p. 5);

(2) Models suggest that even moderate increases in precipitation would not offset the negative impacts to the water supply caused by increased temperature (p. 5);

(3) Temperature increases in the Southwest are predicted to continue to be greater than the global average (p. 5);

(4) There will be a delay in the arrival of snow and acceleration of spring snow melt, leading to a rapid and earlier seasonal runoff (p. 6); and

(5) The intensity, frequency, and duration of drought may increase (p. 7).

By the late 21st century, one simulation predicts no sustained snowpack south of Santa Fe or in the Sangre de Cristo Mountains (State of New Mexico 2006, p. 13). Snow pack would remain in far northern New Mexico and southern Colorado but would be greatly reduced in mass, with a decrease in water mass between one-third and one-half (State of New Mexico 2006, p. 14).

Consistent with the outlook presented for New Mexico, Hoerling (2007, p. 35) states that, relative to 1990–2005, simulations indicate that a 25 percent decline in stream flow will occur from 2006–2030 and a 45 percent decline will occur from 2035–2060 in the Southwest. Seager *et al.* (2007, p. 1181) show that there is a broad consensus among climate models that the Southwest will get drier in the 21st century and that the transition to a more arid climate is already under way. Only one of 19 models has a trend toward a wetter climate in the Southwest (Seager *et al.* 2007, p. 1181). Stewart *et al.* (2004, p. 1152) show that timing of spring streamflow in the western United States during the last five decades has shifted so that the major peak now arrives 1 to 4 weeks earlier, resulting in less flow in the spring and summer. They conclude that almost everywhere in North America, a 10 to 50 percent decrease in spring-summer streamflow fractions will accentuate the seasonal summer dry period with important consequences for warm-season water supplies, ecosystems, and wildfire risks (Stewart *et al.* 2004, p. 1154). An increase in average mean air temperature of just over 1 °C (2.5 °F) in Arizona and just under 1 °C (1.8 °F) in New Mexico since 1976 has already been documented (Lenart 2007, p. 4). Udall (2007, p. 7) found that multiple independent data sets confirm widespread warming in the West. Long-term studies (25 plus years) of Mexican jays (*Aphelocoma ultramarina*) in Arizona and of yellow-bellied marmots (*Marmota flaviventris*) in the Rocky Mountains indicate changes in the timing of important life history events (e.g., breeding, emergence from hibernation) for both species related to warmer temperatures (Parmesan and Galbraith 2004, pp. 18, 19).

As we will discuss below, climate change is predicted to have four major effects on the cold water habitat occupied by Rio Grande cutthroat trout: (1) Increased water temperature; (2) decreased stream flow; (3) a change in the hydrograph (a graphical representation of the distribution of water discharge or runoff over a period of time); and (4) an increased occurrence of extreme events (fire, drought, and floods).

Increased Water Temperature

Water temperature influences the survival of salmonids in all stages of their life cycle. Alterations in the temperature regime from natural background conditions negatively affect population viability, when considered at the scale of the watershed or individual stream (McCullough 1999, p. 160). Salmonids are classified as coldwater fish with thermal preferences centered around 15 °C (59 °F) (Shuter and Meisner 1992, p. 8). High temperatures suppress appetite and growth, can influence behavioral interactions with other fish (Shrank *et al.* 2003, p. 100), or can be lethal

(McCullough 1999, p. 156). Salmonids inhabiting warm stream segments have higher probabilities of dying from stress (McCullough 1999, p. 156).

Eaton and Scheller (1996, p. 1111) state that the maximum temperature tolerance for cutthroat trout is 23.3 °C (74 °F), but Dunham *et al.* (2003b, p. 1042) state that Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) show signs of stress (decreased growth and appetite and increased mortality) when water temperature exceeds 22 °C (71.6 °F) for even a short time (less than 1 day). For Bonneville cutthroat trout, the 7-day upper incipient lethal temperature (temperature lethal to 50 percent of the fish) was 24.2 °C (75.6 °F) under constant thermal conditions (Johnstone and Rahel 2003, p. 96). However, when the temperature was cycled daily between 16–26 °C (60.8–78.8 °F) for 7 days, similar to what the trout would experience in high mountain streams, all trout survived (Johnstone and Rahel 2003, p. 97). Dickerson and Vineyard (1999, pp. 519, 520) found a similar result (cycling between 20 and 26 °C (68 and 78.8 °F)) for Lahontan cutthroat trout. Although trout may survive cyclic exposures to high temperatures, growth is slowed or stopped due to the high metabolic costs and reduced food intake (Dickerson and Vineyard 1999, p. 519; Johnstone and Rahel 2003, p. 98).

Although temperature preferences of Rio Grande cutthroat trout have not been researched specifically, their optimum growth temperature (appetite is high and maintenance requirements low) is most likely in the range of 13–15 °C (55.4–59 °F), similar to other cutthroat trout (Meeuwig *et al.* 2004, p. 213; Bear *et al.* 2007, p. 1118) and their upper incipient lethal limit is most likely near 23–24 °C (73.4–75.2 °F), as has been found for other subspecies of cutthroat trout (Wagner *et al.* 2001, p. 434; Johnstone and Rahel 2003, p. 97). Upper incipient lethal limit (temperature at which 50 percent of the fish can survive for 7 days) for rainbow trout ranges from 24–26 °C (75.2–78.8 °F), for brown trout 23–26 °C (73.4–78.8 °F), and for brook trout 24–25 °C (75.2–77 °F) (McCullough 1999, pp. 47, 48), which means these nonnative trout are better able to tolerate higher water temperatures than cutthroat trout.

The IPCC states that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change (Kundzewicz *et al.* 2007, p. 192). Species with narrow temperature tolerances will likely experience the greatest effects from climate change, and it is anticipated that populations located at the margins of species' hydrologic and geographic distributions will be affected first (Meisner 1990a, p. 282). Climate change has already had or is predicted to have negative consequences on coldwater fisheries globally (Nakano *et al.* 1996, p. 711; Hari *et al.* 2006, p. 24), across North America (Meisner 1990a, pp. 287, 290; Regier and Meisner 1990, p. 11; Carpenter *et al.* 1992, p. 124; Eaton and Scheller 1996, p. 1111; O'Neal 2002, p. 3; Poff *et al.* 2002, p. iv; Chu *et al.* 2005, p. 303; Preston 2006, pp. 106, 107, 110, 111, 115; Reiman *et al.* 2007, pp. 1553, 1558), and in the Southwest and Rocky Mountains specifically (Keleher and Rahel 1996, p. 1; Rahel *et al.* 1996, pp. 1116, 1122; O'Neal 2002, pp. 43, 44; Preston 2006, pp. 101, 102, 113) through increases in ground and surface water temperature.

The magnitude of habitat loss due to increased water temperature depends on the climate change model used, the model used to predict the air temperature/water temperature relationship, and the timeframe. Keleher and Rahel (1996, p. 4) found that the distribution of salmonids in Wyoming streams was limited to areas where mean July air temperature did not exceed 22 °C (71.6 °F). They projected that for temperature increases of 1, 2, 3, 4, or 5 °C, there would be a corresponding loss of area suitable for salmonids of 16.2, 29.1, 38.5, 53.3, and 68.0 percent, respectively (Keleher and Rahel 1996, p. 4). Rahel *et al.* (1996) used three approaches to examine potential salmonid habitat loss due to warming in the North Platte river drainage of the Rocky Mountains. They found that there was a loss of 9 to 76 percent of coldwater habitat based on air temperature increases of 1 to 5 °C (Rahel *et al.* 1996, p. 1120). Other studies have predicted losses of 18–92 percent of suitable natal bull trout (*Salvelinus confluentus*) habitat (Rieman *et al.* 2007, p. 1558), and Preston (2006, p. 92), in a re-analysis of other studies, found a 20, 35, and 50 percent loss of coldwater habitat from the Rocky Mountains in 2025, 2050, and 2100, respectively.

In these studies, habitat loss occurs in the lower elevation stream reaches (or lower latitude streams) due to increased temperatures. As a result, salmonid populations will be restricted to increasingly higher elevations or to more northern latitudes (Meisner *et al.* 1988, p. 6; Regier and Meisner 1990, p. 11; Keleher and Rahel 1996, p. 2; Nakano *et al.* 1996, pp. 716, 717; Rahel *et al.* 1996, p. 1122; Poff *et al.* 2002, p. 7; Rieman *et al.* 2007, p. 1558). Consequently, coldwater species occupying the southern distributions of their range are seen as more susceptible to extirpation as a consequence of global climate change (Poff *et al.* 2002, p. 8; Rieman *et al.* 2007, pp. 1552, 1553). Rio Grande cutthroat trout are the southernmost subspecies of cutthroat trout (Behnke 2002, p. 143).

Rio Grande cutthroat trout primarily occupy high-elevation headwater tributaries. Dispersal to new habitats is unlikely because they currently occupy the uppermost available habitat. Warming of lower elevation stream segments may limit restoration opportunities in the future and provide a competitive advantage to brown, rainbow, and brook trout in locations where these nonnatives occur with Rio Grande cutthroat trout (De Staso and Rahel 1994, pp. 293, 294; Dunham *et al.* 2002, p. 380; Paroz 2005, p. vi; Bear *et al.* 2007, p. 1118; Shemai *et al.* 2007, p. 322).

The Santa Fe and Carson National Forests have monitored stream temperature data using thermographs (instruments that record temperature at designated intervals, e.g., once every 4 hours) (Eddy 2005, Martinez 2007). From 2001–2003, 47 thermograph stations were used to monitor 21 streams on the Santa Fe National Forest, representing 385 km (239 mi) of stream (Eddy 2005, p. 5). Seven of the 21 streams are currently occupied by Rio Grande cutthroat trout conservation populations; all 21 are believed to be historical habitat. Temperature data collected were compared with New Mexico Environment Department (NMED) standards for high quality coldwater fisheries and with Santa Fe National Forest standards, which are slightly more stringent than NMED but are more in line with standards for coldwater fisheries in the western States (Table 3) (Eddy 2005, p. 4). ''Properly functioning'' indicates that the water temperature of the stream is within the optimal range for feeding, physiology, and behavior for coldwater fish. ''At risk'' indicates that the water temperature is slightly warmer than optimal, and ''not properly functioning'' indicates that the water temperature is too warm to support a healthy coldwater fishery.

TABLE 3.—SANTA FE NATIONAL FOREST AND NMED

[Water quality temperature standards for high quality coldwater fisheries]

Water temperature standards	Properly functioning	At risk	Not properly functioning
Santa Fe National Forest 7-Day Average Maximum	≤64 °F (≤17.8 °C)	64 to 70 °F (17.8–21.1 °C)	>70 °F (>21.1 °C).
NMED 3-Day Average Maximum	<68 °F (<20 °C)	68 to <73.4 °F (20 to <23 °C)	≥73.4 °F (23 °C).

Using the Santa Fe National Forest standards, stream segments represented by 12 thermograph stations were properly functioning (67.3 km (41.8 mi)), stream segments represented by 20 stations were at risk (162.1 km (100.7 mi)), and stream segments represented by 15 stations were not properly functioning (154.7 km (96.1 mi)) (Eddy 2005, p. 5). Using NMED standards, stream segments represented by 23 stations (172.7 km (107.3 mi)) were properly functioning, stream segments represented by 12 stations (82.2 km (51.1 mi)) were at risk, and stream segments represented by 12 stations (129.1 km (80.2 mi)) were not properly functioning (Eddy 2005, p. 5). Only nine streams were properly functioning for their entire length, using both standards. Of these, only one is occupied by a Rio Grande cutthroat trout conservation population (Cave Creek) (Eddy 2005, p. 5). The Pecos River and Rio de las Vacas are properly functioning in occupied Rio Grande cutthroat trout habitat but have at risk (Pecos River) or not properly functioning sections (Rio de las Vacas) below occupied habitat (Eddy 2005, pp. 34, 35, 92). Canones, Polvadera, and Rio Cebolla were the other streams monitored that have conservation populations of Rio Grande cutthroat trout. These streams were identified as at risk or not properly functioning (Rio Cebolla) in occupied habitat (Eddy 2005, pp. 9, 19, 26).

Monitoring on the Carson National Forest indicated that Comanche Creek had several periods in which temperature standards were exceeded (Martinez 2007, pp. 3–22). Eight sites on Comanche Creek were monitored in 1998, 1999, and 2004. Temperatures were highest in 1998 and 1999, years of lower runoff. Temperatures in 1998 were very high, with 5 of the 8 sites recording temperatures from 26.6–29.5 °C (80–85 °F) (Martinez 2007, pp. 3–22). At the remaining three sites, temperatures reached 26.4 °C (79.5 °F). Thermographs went in on June 23 each year, and in 1998, maximum temperatures ranged from 22.9–24 °C (73.2–76 °F) at all eight sites on the first day the recorders were deployed, indicating that there were probably several days of warm temperatures that occurred before monitoring began (Martinez 2007, pp. 3–22). In total, of 14 streams occupied by Rio Grande cutthroat trout and monitored by thermographs on the Santa Fe and Carson National Forests, 8 streams were either at risk or not properly functioning because of high water temperature (NMED 2007, pp. 15–331; Eddy 2005, pp. 8–116; Martinez 2007, pp. 3–22). An additional conservation population in Colorado was also identified at risk from high water temperatures by Pritchard and Cowley (2006, p. 39). Because only a fraction of the streams occupied by Rio Grande cutthroat trout have been monitored, there are likely more that are at risk.

The thermograph data collected on the Santa Fe and Carson National Forests indicate that stream temperatures in several streams are already at risk or are considered ''not properly functioning'' for trout. Because air temperature and consequently water temperature are expected to increase with climate change, we would anticipate that more streams that are currently not properly functioning will become unsuitable for Rio Grande cutthroat trout, those currently at risk will enter the not properly functioning category, and more streams will fall into the at risk category for temperature. As a consequence, suitable habitat will decrease and fragmentation will increase.

In contrast to the potential negative impacts of water temperature increase on Rio Grande cutthroat trout, there could also be a potential benefit. Cold summer water temperatures (mean July temperature of less than 7.8 °C (46 °F)) have been found as a limiting factor to recruitment of cutthroat trout in high-elevation streams (Harig and Fausch 2002, p. 545; Coleman and Fausch 2007, pp. 1238–1240). Coleman and Fausch (2007, p. 1240) found that cold summer water temperatures in Colorado streams likely limited recruitment of cutthroat trout because of reduced survival of age-0 fish (fish less than 1 year old). Harig and Fausch (2002, p. 538) recorded summer water temperatures in 5 streams in New Mexico and 11 streams in Colorado from 1996 to 1999 (Harig and Fausch 2002, p. 540). None of the streams in New Mexico had July water temperatures below 7.8 °C (46 °F) (lowest July average was in the Pecos River, 9.2 °C (48.6 °F)). Three of four streams in Colorado that no longer had translocated fish present had summer averages below 7.8 °C (46 °F) (Harig and Fausch 2002, pp. 538, 539). The remaining 8 streams in Colorado had summer averages ≥8.3 °C (46.9 °F), indicating that cold summer water temperatures were most likely not limiting for these Rio Grande cutthroat trout populations (Harig and Fausch 2002, pp. 538, 539). Two of the four streams (Little Medano and Unknown Creek), which no longer had transplanted fish at the time of Harig and Fausch's research (1996–1998), dried in 2002 (Alves *et al.* 2007, pp. 43, 44), raising the possibility that insufficient refugial habitat may have been limiting, not low summer water temperatures.

Cold summer water temperatures have been identified as limiting in one stream: Deep Canyon, Colorado (Pritchard and Cowley 2006, p. 42). However, Alves *et al.* (2007 database) indicate that Deep Canyon has temperatures from 8 to 16 °C (46.4 to 60.8 °F) during spawning and incubation periods. Of the 14 Rio Grande cutthroat trout streams monitored with thermographs on the Santa Fe and Carson National Forests, two (Pecos and Mora rivers) were found to have July temperatures less than 7.8 °C (46 °F) (data summarized from Eddy 2005, Martinez 2007). The result for the Pecos River contrasts with the data Harig and Fausch (2002, p. 540) collected (9.2 °C (48.6 °F)) and likely reflects a difference in thermograph placement or year (e.g., temperature variability, amount of runoff).

In summary, we find that data collected thus far indicate that warm water temperatures have already reached the likely limits of suitability in some Rio Grande cutthroat trout streams and several others are at risk. Water temperatures are expected to increase in the future, affecting more streams and making lower elevation reaches either marginal or unsuitable. This is particularly true for populations that are located in New Mexico and are at the southernmost extent of the range but could also be true for smaller streams in Colorado. Although cold water temperatures are limiting to some high-elevation salmonid populations, cold water limitation has not been convincingly demonstrated for any Rio Grande cutthroat trout population. Therefore, we view the negative impact of stream warming to outweigh any benefit that may occur from increased water temperature.

The studies cited above that forecast coldwater habitat loss, calculate the loss of habitat based on increases in temperature alone, assuming temperatures will rise above the thermal tolerance limits of coldwater species, thereby limiting the amount of suitable habitat available. The ancillary effects of increased temperature, such as increased habitat fragmentation (Rahel *et al.* 1996, pp. 1121, 1122; Rieman *et al.* 2007, pp. 1553, 1560, 1562), changes in invertebrate prey base (both species composition and availability) (Ries and Perry 1995, p. 204; O'Neal 2002, p. 4; IPCC 2002, p. 17; Harper and Peckarsky 2006, p. 618; Bradshaw and Holazpel 2008, p. 157), effects on spawning (Jager *et al.* 1999, p. 236), increased competitive interactions with nonnative trout (Meisner 1990b, p. 1068; De Staso and Rahel 1994, pp. 289, 294; O'Neal 2002, p. 33; Chu *et al.* 2005, p. 307; Sloat *et al.* 2005, p. 235), additional invasive species (IPCC 2002, p. 32), increased susceptibility to disease (Hari *et al.* 2006, p. 24), and effects on water quality (e.g., dissolved oxygen, nutrients, pH) (Meisner *et al.* 1988, p. 7), are not considered in calculating the potential habitat loss.

Of these factors, increased fragmentation, increased effects from nonnative fish, and increased disease risk are considered of particular importance to Rio Grande cutthroat trout and are discussed in more detail.

Fragmentation. Climate change is predicted to increase fragmentation of coldwater fish habitat (Nakano *et al.* 1996, p. 719; Rahel *et al.* 1996, p. 1122; Rieman *et al.* 2007, p. 1553). Currently, 112 of 120 (93 percent) conservation populations of Rio Grande cutthroat trout exist as fragments, with no well-connected populations (Alves *et al.* 2007, p. 29). Only one population has a moderate degree of connectivity (Comanche Creek) (2007 database). As noted above, Comanche Creek currently has very high water temperatures (Martinez 2007, pp. 3–22), and several of the small tributaries of upper Comanche Creek dried in 2006 (Patten *et al.* 2007, p. 76). Consequently, the one moderately well-connected population may already be at risk. Seven Rio Grande cutthroat trout conservation populations are considered weakly networked (occupied habitat consists of 2–3 connected streams, possible infrequent straying of adults may occur) (Alves *et al.* 2007, p. 77). Of these seven, six have connecting stream segments less than 5 feet in width (2007 database), and are therefore considered at risk from drying. Consequently, fragmentation of these weakly networked systems appears reasonably likely in the foreseeable future.

Nonnative Fish Interactions. Water temperature is a determining factor in the distribution of salmonids (Rahel and Hubert 1991, p. 326; Schrank *et al.* 2003, p. 100; Sloat *et al.* 2005, p. 225). Additionally, temperature regime is a key determinant of the outcome of competitive interactions in a fish community (MuCullough 1999, p. 156). Fish living within their optimum temperature range have improved performance relative to other species not within their optimum range (MuCullough 1999, p. 156). There is evidence that the reason cutthroat trout occupy headwater streams and rainbow, brook, and brown trout occupy downstream reaches is because of the influence of temperature on competitive abilities (Dunham *et al.* 2002, p. 380). DeStaso and Rahel (1994, pp. 293, 294) looked at competition between Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) and brook trout. They found that at warmer water temperatures (20 °C (68 °F)) brook trout was dominant, as evidenced by a higher level of interspecific aggression, more time spent at the optimal feeding position, and greater food consumption (DeStaso and Rahel 1994, pp. 293, 294). Brook trout also tolerated higher temperatures (DeStaso and Rahel 1994, p. 294).

As mentioned earlier, when brook trout co-occur with cutthroat trout, species interactions act to suppress cutthroat trout populations (Dunham *et al.* 2002, p. 378; Young and Guenther-Gloss 2004, p. 193; Peterson *et al.* 2004, pp. 765–769). Because brook trout tolerate higher temperatures, warmer stream temperatures would provide a competitive advantage to brook trout over Rio Grande cutthroat trout, exacerbating the problems that already exist for Rio Grande cutthroat trout populations.

In New Mexico, brown trout is the most common nonnative trout present in Rio Grande cutthroat trout conservation populations (summarized from 2007 database). Jager *et al.* (1999, p. 232) modeled the effects of an increase of 2 °C air temperature on brown trout distribution in the Sierra Nevada, California. They found that brown trout numbers would increase in upstream cooler reaches, and decrease downstream through starvation of juvenile and adult fish (Jager *et al.* 1999, p. 235). This is consistent with observations in Switzerland. In Switzerland in 1987, after a long period of essentially stable river water temperatures, water temperatures took an abrupt and significant increase to a higher mean level, which was attributed to a corresponding increase in air temperature (Hari *et al.* 2006, pp. 10, 21). Suitable habitat for brown trout, a trout species native to the area, moved upstream, and downstream portions became unsuitable (Hari *et al.* 2006, pp. 10, 21).

McHugh and Budy (2005, p. 2791) hypothesized that cold incubation temperatures might explain why brown trout did not form self-sustaining populations at high elevations in Logan River, Utah, where upstream water temperatures were not too cold for adult brown trout. Because brown trout have a higher optimal growth temperature (between 13–18 °C) than cutthroat trout (12–13 °C), and because cold incubation temperatures may currently be limiting brown trout range expansion upstream, it is anticipated that warmer water temperatures will make additional upstream habitat suitable for brown trout, reducing the area where Rio Grande cutthroat trout are now dominant.

When cutthroat trout co-occur with rainbow trout, cutthroat trout typically occupy the upper colder reaches and rainbow trout occupy the lower, warmer stream reaches (Sloat *et al.* 2005, p. 235; Robinson 2007, p. 80). As identified by Alves *et al.* (2007, p. 35), rainbow trout occupy the same stream reaches as four conservation populations of Rio Grande cutthroat trout. Rainbow trout have a higher thermal tolerance than do cutthroat trout (Bear *et al.* 2007, pp. 1115, 1116). Because rainbow trout are able to tolerate higher temperatures than Rio Grande cutthroat trout, we expect that warming stream temperatures will give rainbow trout a competitive advantage over Rio Grande cutthroat trout. Monitoring and maintenance of barriers will continue to be essential, to prevent hybridization and competition.

White sucker is native to the middle elevations of the Pecos and Canadian river drainages in New Mexico, but it has been introduced widely throughout the State and is sympatric with at least two populations of Rio Grande cutthroat trout (Sublette *et al.* 1990, p. 199; 2007 database). White sucker has a preferred water temperature of 22.4–27.1 °C (72.3–80.8 °F) (Sublette *et al.* 1990, p. 198). Sublette *et al.* (1990, p.199) note that white sucker is highly fecund (able to reproduce) and often dominates a body of water. Comanche Creek (elevation approximately 2900 m (9500 ft)) has an abundant white sucker population, most likely due to the warm water temperatures discussed above. In 2007, over 20,000 white sucker were removed from Comanche Creek during a Rio Grande cutthroat trout restoration project (Patten 2007). Before the restoration, fish biomass was dominated by white sucker, and an inverse relationship was found between Rio Grande cutthroat trout density and white sucker density (Patten *et al.* 2007, pp. 17, 18). Because both white sucker and Rio Grande cutthroat trout feed on aquatic insects, there is the potential for high numbers of white sucker to negatively impact food availability for Rio Grande cutthroat trout. We would anticipate the warmer stream temperatures would lead to more stream habitat becoming suitable for white sucker with potential negative impacts on Rio Grande cutthroat trout populations.

Disease. As mentioned earlier (see the ''Disease and Predation'' section in Factor C above) it had been thought that Rio Grande cutthroat trout were provided some level of protection against whirling disease because tubificid worms are most abundant in warm, degraded habitats and Rio Grande cutthroat trout occur in high-elevation, coldwater streams (67 FR 39943). However, Nehring (2007, p. 10) found equal abundance of lineage III tubificid worms in elevations from 1,829 m (6,000 ft) to 3,657 m (12,000 ft). Thus, it is clear that elevation does not provide protection from exposure to the disease.

El-Matubouli *et al.* (1999) found that temperatures from 10–15 °C (50–59 °F) were optimum for development and maturation of the parasite inside the tubificid worm. Blazer *et al.* (2003, p. 24) found that the greatest production of TAMs occurred at temperatures from 13–17 °C (55.4–62.6 °F). Although the effect of temperature on survival of the tubificid worms was not statistically detectable, DuBey *et al.* (2005, p. 341) found that survival was consistently higher at 17 °C (62.6 °F) than at 5 °C (41 °F). Schisler *et al.* (2000, p. 862) found that multiple stressors on rainbow trout, especially the combination of *M. cerebralis* infection and temperature, increased mortality drastically. At 12.5 °C (54.5 °F) mean mortality of rainbow trout exposed to *M. cerebralis* was 41.7 percent. Mean mortality of rainbow trout exposed to *M. cerebralis* and held at a temperature of 17 °C (62.6 °F) was 60 percent (Schisler 2000, p. 861). Water temperature often exceeds 17 °C (62.6 °F) in July and August in Rio Grande cutthroat trout streams that have been monitored (Eddy 2005, Martinez 2007).

Thompson *et al.* (1999, p. 318) found that as water temperature increased from May to July, rainbow and cutthroat trout infected with *M. cerebralis* suffered high rates of mortality even though they had survived well in the winter. In a field study of the effects of water temperature, discharge, substrate size, nutrient concentration, primary productivity, and relative abundance of *T. tubifix,* de la Hoz Franco and Budy (2004, p. 1183) found that prevalence of *M. cerebralis* in trout increased with water temperature. Across sites where cutthroat trout were present, the lowest prevalence of infection occurred in the headwaters where average daily water temperature was 9.2 °C (48.6 °F), whereas the highest levels of infection occurred at a low elevation site where the temperature was the highest (>12 °C (53.6 °F)) (de la Hoz Franco and Budy 2004, p. 1186).

While water temperature in some streams may warm to the point (>20 °C (68 °F)) of inhibiting the production of TAMs (Blazer *et al.* 2003, p. 24), it is anticipated that the overall increases in water temperature will be favorable for *T. tubifix* and TAM production. From these studies we conclude that elevation does not provide protection to Rio Grande cutthroat trout populations and that increasing water temperature would increase the production of TAMs and the survival of tubificid worms (up to about 20 °C (68 °F)), and increased water temperature would increase mortality of infected Rio Grande cutthroat trout.

In summary, stream warming will most likely decrease the amount of suitable habitat available for Rio Grande cutthroat trout. Warmer stream temperatures may in the foreseeable future make currently occupied reaches of stream more stressful or unsuitable. Suitable habitat is likely to be reduced, primarily at the downstream end of stream reaches and in small tributaries, leading to increased fragmentation, shorter occupied segments, and increased risk of extirpation. Warmer water temperatures will allow nonnative fishes to expand their range and give them a competitive advantage over Rio Grande cutthroat trout. Stress from warm water temperatures increases susceptibility to and mortality from disease. Although whirling disease positive sites are currently still limited within the range of Rio Grande cutthroat trout, managers will need to continue to monitor the disease closely. Increased water temperatures would increase the threat posed by whirling disease.

Decreased Stream Flow

Current models suggest a decrease in precipitation in the Southwest (Seager *et al.* 2007, p. 1181; Kundzewicz *et al.* 2007, p. 183), which would lead to reduced stream flows and a reduced amount of habitat for Rio Grande cutthroat trout. Stream flow is also predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, p. ix; State of New Mexico 2005, p. 6; Hoerling 2007, p. 35). Winter and spring warming causes an increased fraction of precipitation to fall as rain, resulting in a reduced snow pack, an earlier snowmelt, and decreased summer runoff (Christensen *et al.* 2004, p. 4; Stewart *et al.* 2005, p. 1137; Regonda *et al.* 2005, p. 373). Earlier snowmelt and warmer air temperatures lead to a longer dry season, which affects stream flow. Warmer air temperatures lead to increased evaporation, increased evapo-transpiration, and decreased soil moisture. These three factors would lead to decreased stream flow even if precipitation increased moderately.

The effect of decreased stream flow is that streams become smaller, thereby reducing the amount of habitat available for aquatic species (Lake 2000, p. 577). A smaller stream is affected more by air temperature than a larger one, exacerbating the effects of warm (and cold) air temperature (Smith and Lavis 1975, p. 229). Small headwater streams, such as those occupied by Rio Grande cutthroat trout, and intermittent streams may dry completely. Seventy-one percent of Rio Grande cutthroat trout streams are less than 8 km (5 mi) in length (Alves *et al.* 2007, p. 26). Because stream length is one indicator of population viability (Harig *et al.* 2000, p. 997; Hilderbrand and Kershner 2000, p. 515; Young *et al.* 2005, p. 2405; Cowley 2007 10.1002/aqc.845), further shortening of Rio Grande cutthroat trout streams due to drying is expected to have a negative impact on populations.

In fact, fourteen Rio Grande cutthroat trout streams with conservation populations became intermittent, and had populations negatively impacted or lost because of the 2002 drought (Japhet *et al.* 2007, pp. 42–44; Patten *et al.* 2007, pp. 14, 31, 32, 34, 39, 76). The number of streams impacted was most likely higher, because managers only survey a fraction of the 120 conservation populations in any given year. Approximately 27 conservation populations are in streams that are 1.5 m (5 ft) or less in width throughout their entire length (2007 database). An additional 29 stream segments that are tributaries to the conservation populations are also less than 1.5 m (5 ft) in width (2007 database), which indicates that fragmentation of existing connected populations could increase. We recognize that not all streams less than 1.5 m (5 ft) wide have an equal probability of drying. Some are likely spring fed or are narrow and deep, thus decreasing the likelihood of drying. However, because of the high number of Rio Grande cutthroat trout streams less than 8 km (5 mi) in length (71 percent of conservation populations) and less than 1.5 m (5 ft) wide, the risk of drying is considered high.

Insight into the effects that climate change may have on headwater streams is provided by research done at the Experimental Lakes Area in northwestern Ontario (Schindler *et al.* 1996). The experimental area was set up in 1968, and precipitation, evaporation, air temperature, wind velocity, and other meteorological and hydrological parameters were monitored continuously throughout the 1970 to 1990 study period (Schindler *et al.* 1996, p. 1005). During this period, the area experienced gradual air temperature warming (1.6 °C (2.9 °F)) and decreased precipitation (as measured by a decline of over 50 percent in annual runoff) (Schindler *et al.* 1996, p. 1004). Whether these changes can be attributed to climate change or local variation is unknown, but they are consistent with changes that are predicted under global climate change scenarios. In the early 1970s, two streams in the area were perennial and one stream was dry for less than 10 days per year. By the late 1980s all three streams were dry for 120–160 days during the summer (Schindler *et al.* 1996, p. 1006). Because northern latitude ecosystems mimic higher elevation systems in southern latitudes, the effects seen on these streams likely represent what may happen at high-elevation streams in New Mexico and Colorado, within the range of Rio Grande cutthroat trout.

In summary, stream drying has already had a negative impact on several Rio Grande cutthroat trout populations; 71 percent of Rio Grande cutthroat trout conservation populations are in stream fragments 8 km (5 mi) or less in length, and many of the populations are in streams less than 1.5 m (5 ft) wide. Further, the increased risk of stream drying as a result of climate change, leading to shorter stream segments and increased fragmentation, is seen as high. A rangewide emergency rescue and evacuation plan does not exist for Rio Grande cutthroat trout and would likely not be effective. If widespread drought were to occur, affecting many streams at the same time, it is unclear if sufficient facilities or donor streams exist to accept the rescued fish, or if the effort would take place according to a carefully conceived, well-organized plan.

Change in Hydrograph

Changes in air temperature and precipitation will likely lead to changes in the magnitude, frequency, timing, and duration of runoff (Poff *et al.* 2002, p. 4). Stewart *et al.* (2004, p. 1152) show that spring streamflow during the last five decades has shifted so that the major peak now arrives 1 to 4 weeks earlier, resulting in declining fractions of flow in the spring and summer. The life history of salmonids is closely tied to the flow regime, runoff in particular (Fausch *et al.* 2001, p. 1440). A change in timing or magnitude of floods can scour the streambed, destroy eggs, or displace recently emerged fry downstream (Erman *et al.* 1988, p. 2199; Montgomery *et al.* 1999, p. 378; Fausch *et al.* 2001, p. 1440). The environmental cues for spawning of Rio Grande cutthroat trout are not known with certainty, but they are most likely tied to increasing water temperature, increasing day length, and possibly flow, as it has been noted that they spawn when runoff from snowmelt has peaked and is beginning to decrease (Behnke 2002, p. 141; Pritchard and Cowley 2006, p. 25). Consequently, a change in the timing of runoff from spring to winter could disrupt spawning cues because peak flow would occur when the days are still short in length and water temperatures cold.

Increased winter temperatures cause more precipitation to fall as rain instead of snow (Regonda *et al.* 2005, p. 373). Snow covering small streams provides valuable insulation that protects aquatic life (Needham and Jones 1959, p. 470; Gard 1963, p. 197). Gard (1963, p. 196) measured temperatures above, within, and below the snow at Sagehen Creek, California, a small Sierra Nevada mountain stream. He found that although there was a 35.4 °C (63.8 °F) diurnal air temperature variation, within the snow the temperature variation was only 1.3 °C (2.3 °F) and the water temperature in the stream below varied by only 0.3 °C (0.55 °F). Stream freezing, which is more likely absent insulating snow cover, has been suggested as the cause of the extirpation of one Rio Grande cutthroat trout population (Ferrell 2006, p. 11). Anchor ice (ice frozen on the stream bed) and frazil ice (ice crystal suspended in the water) can also have negative impacts on trout (Needham and Jones 1959, p. 465). High-elevation streams are rarely visited in winter; consequently, it is difficult to document the extent to which freezing may impact populations. However, the combination of reduced stream flow and reduced snow pack could lead to an increased probability of stream freezing in small headwater Rio Grande cutthroat trout streams.

Earlier snowmelt, which leads to less flow in the spring and summer, could either benefit Rio Grande cutthroat trout or be detrimental. The benefit could come because the young-of-year would have a longer growing season before winter. However, as discussed above, a longer season of lower flows would lead to increased stream temperatures and increased probability of intermittency and drying.

In summary, it is difficult to project how changes in the hydrograph as a result of climate change will affect Rio Grande cutthroat trout populations. If growing season is increased, water temperatures remain suitable, and the stream does not dry, a beneficial effect could occur. If spawning cues are disrupted or egg and fry success is reduced because of winter floods or unseasonal extreme floods, a negative impact would occur. In addition, stream freezing may reduce suitable over-winter habitat or reduce population size in susceptible streams.

Extreme Events

An increase in extreme events such as drought, fires, and floods is predicted to occur because of climate change (IPCC 2007a, p. 15). It is anticipated that an increase in extreme events will most likely affect populations living at the edge of their physiological tolerances. The predicted increases in extreme temperature and precipitation events may lead to dramatic changes in the distribution of species or to their extirpation or extinction (Parmesan and Matthews 2006, p. 344).

Drought. The relatively short-term drought of the early 2000s had a negative impact on or extirpated 14 Rio Grande cutthroat trout populations in Colorado and New Mexico (Japhet *et al.* 2007, pp. 42–44; Patten *et al.* 2007, pp. 14–40). A fifteenth population is thought to have been extirpated in 2006 by complete freezing caused by low flow in the winter (Ferrell 2006, p. 11). As discussed above, in the ‘‘Decreased Stream Flow’’ section, it is anticipated that a prolonged, intense drought would affect many Rio Grande cutthroat trout populations, in particular those less than 1.5 m (5 ft) wide and less than 8 km (5 mi) long because of their small size.

Most Rio Grande cutthroat trout populations are currently protected from downstream populations of nonnative trout by barriers. Downstream reaches are larger streams that historically could have provided refugia for populations threatened by stream drying. If Rio Grande cutthroat trout disperse downstream now, they are lost from their conservation population once they pass over the barrier because they will not be able to pass back over the barrier moving the upstream direction. In the future, downstream water temperatures may be too warm to be suitable for Rio Grande cutthroat trout. In addition to stream drying, there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1994, pp. 11, 24, 28), as discussed below.

Fire. Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970–1986. The total area burned is more than six and a half times the previous level (Westerling *et al.* 2006, p. 941). In addition, the average length of the fire season during 1987–2003 was 78 days longer compared to 1970–1986 and the average time between fire discovery and control increased from 7.5 days to 37.1 days for the same timeframes (Westerling *et al.* 2006, p. 941). McKenzie *et al.* (2004, p. 893) suggest, based on models, that the length of the fire season will likely increase further and that fires in the western United States will be more frequent and more severe. In particular, they found that fire in New Mexico appears to be acutely sensitive to summer climate and temperature changes and may respond dramatically to climate warming.

Changes in relative humidity, especially drying over the western United States, are also projected to increase the number of days of high fire danger (Brown *et al.* 2004, p. 365). High-elevation, subalpine forests in the Rocky Mountains typically experience infrequent (i.e., one to many centuries), high severity crown fires (Schoennagel *et al.* 2004, p. 664). These fires usually occur in association with extremely dry regional climate patterns (Swetnam and Baisan 1994, p. 28; Schoennagel *et al.* 2004, p. 664). Short drying periods do not create the conditions appropriate for fire in these typically cool, humid forests. Schoennagel *et al.* (2004, p. 665, 666) conclude that recent increases in the area burned in subalpine forests are not attributable to fire suppression but that variation in climate exerts the largest influence on the size, timing, and severity of the fires. In contrast, low-elevation, ponderosa pine forests in the Rocky Mountains were historically characterized by frequent, low-severity fires (Schoennagel *et al.* 2004, p. 669). Fire suppression has significantly increased ladder fuels (fuels that allow fire to climb from the forest floor to the tops of trees) and tree densities leading to unprecedented high-severity fires in these ecosystems (Schoennagel *et al.* 2004, p. 669). Rio Grande cutthroat trout streams occur in both forest types.

As discussed in the ''Fire'' section in Factor A above, because of the observed and predicted increase in fire season length; the predicted increase in frequency and severity of fires; the observation that fuel treatment is only effective in low-elevation, ponderosa pine forests; the expectation of an increase in the frequency of hot extremes, heat waves, and heavy precipitation (IPCC 2007a, p. 15); and the fact that most Rio Grande cutthroat trout streams occur within a forested landscape, we conclude that wildfire associated with climate change will exacerbate habitat loss to Rio Grande cutthroat trout populations across their range.

Floods. The life history of salmonids is tied to the timing of floods (Fausch *et al.* 2001, p. 1440). A change in timing or magnitude of floods can scour the streambed, destroy eggs, or displace recently emerged fry downstream (Erman *et al.* 1988, p. 2199; Montgomery *et al.* 1999, p. 378; Fausch *et al.* 2001, p. 1440). Floods that occur after intense wildfires that have denuded the watershed are also a threat. As described above, in the ''Fire'' section under Factor A, several streams in the Southwest have had populations of trout extirpated as a result of ash flows which occurred after fire (Rinne 1996, p. 654; Brown *et al.* 2001, p. 142; Patten *et al.* 2007, p. 33). Consequently, an increase in rain or snow events, intense precipitation that is unseasonable, or precipitation that occurs after fire could extirpate affected Rio Grande cutthroat trout populations.

In summary, extreme events, especially widespread fire and drought, will likely affect Rio Grande cutthroat trout populations in the foreseeable future through population extirpation, extreme population reduction, or habitat reduction. Several Rio Grande cutthroat trout populations have already been impacted by drought. Fire has thus far primarily affected nonnative trout streams within the range of Rio Grande cutthroat trout, but there is no safeguard for Rio Grande cutthroat trout streams. The impact of a change in the timing of runoff may be significant but is more difficult to predict.

Climate Change Summary

The extent to which climate change will affect Rio Grande cutthroat trout is not known with certainty at this time. Preliminary projections point to a possible rangewide negative impact through increased water temperatures, decreased stream flow, a change in hydrograph, and an increased occurrence of extreme events, which will all tend to exacerbate the threats to the Rio Grande cutthroat trout and its habitat discussed under Factors A and C above. Although the extent that the global climate will change in the future is not known, even a minimal increase in temperature will lead to increased habitat unsuitability and will exacerbate most other known threats to the subspecies.

Fisheries Management

Future management of Rio Grande cutthroat trout will depend in part on the use of hatchery-reared fish. Although hatcheries can produce many fish in a short period of time, the use of hatchery fish is not without risks (Busack and Currens 1995, pp. 73–78). Two recent papers have explored the risks of captive propagation used to supplement species that are declining in the wild (Araki *et al.* 2007, Frankham 2007). Araki *et al.* (2007, p. 102) found that there was approximately a 40 percent decline in reproductive capabilities per captive-reared generation when steelhead trout (*Oncorhynchus mykiss*) were moved to natural environments. Frankham (2007, p. 2) notes that characteristics selected for under captive breeding conditions are overwhelmingly disadvantageous in the natural environment. Minimizing the number of generations in captivity or making the captive environment similar to the wild environment are effective means for minimizing genetic adaptation to captivity (Frankham 2007, pp. 4, 5).

The history of brood stock management in New Mexico has been marked by many challenges (Cowley and Pritchard 2003, pp. 12, 13). The most recent challenges came from whirling disease infection at Seven Springs Hatchery and the discovery that the brood stock was introgressed with Yellowstone cutthroat trout (Patten *et al.* 2007, p. 42). The hatchery was refurbished to eliminate *M. cerebralis* and the brood stock program was restarted in 2005 (Patten *et al.* 2007, p. 42). A recently revised brood stock management plan was completed for

New Mexico (Cowley and Pritchard 2003).

Although the intent of fisheries management is positive, fisheries management may result in unanticipated outcomes. For example, Costilla Creek restoration efforts were unfortunately marred by the introduction of rainbow trout into the recently reclaimed stream (Patten *et al.* 2007, p. 101, Appendices VIII-X). The rainbow trout came from Seven Springs Hatchery, even though this hatchery is designated as a Rio Grande cutthroat trout facility (NMDGF 2002, p. 28; Pattten *et al.* 2007, p. 379). It is unclear why Seven Springs Hatchery was holding rainbow trout. Through a coordinated effort, managers believe they captured most, if not all, of the rainbow trout that were stocked into Costilla Creek along with Rio Grande cutthroat trout (Patten *et al.* 2007, pp. 18, 102). While electrofishing to recover the rainbow trout, two brook trout were also caught, indicating that the lower barrier was compromised, not all the fish were killed during treatment, or that an angler had released the fish above the barrier. In addition, because the stocked Rio Grande cutthroat trout came from Seven Springs Hatchery before the introgression with Yellowstone cutthroat trout was discovered, the Rio Grande cutthroat trout that were stocked were slightly introgressed (Patten *et al.* 2007, p. 102). For these reasons, relying on hatchery-reared Rio Grande cutthroat trout does not provide certainty that repatriation will be successful.

Fisheries managers have worked very hard in the last several years to monitor populations, check and maintain barriers, test the genetic purity of populations, test streams for whirling disease, fund research, and reintroduce populations into appropriate streams (Patten *et al.* 2007, pp. 4–19; Japhet *et al.* 2007, pp. 22–27). New populations have been established in Costilla, South Ponil, Leandro, and Capulin creeks in New Mexico and in Big Springs, East Costilla, and West Costilla creeks in Colorado. Populations were restarted in Cat Creek and Little Medano Creek, Colorado, after being lost to the drought (Japhet *et al.* 2007, pp. 42–44). In addition, major restoration projections have gone through environmental review and are in progress on Placer Creek, Comanche Creek, and Costilla Creek. Completion of these projects will contribute to the long-term persistence of Rio Grande cutthroat trout. The USFS, BLM, and NPS have been active partners in project implementation and have completed many miles of detailed stream surveys, which adds greatly to our knowledge of habitat condition.

New Mexico Tribes and Pueblos have recently taken initiatives to restore Rio Grande cutthroat trout on their homelands. The Mescalero Apache Tribe began inventorying their streams to determine presence, and has reopened the Mescalero Tribal Fish Hatchery. The Tribe hopes to establish a Rio Grande cutthroat trout brood stock and raise Rio Grande cutthroat trout to support native fish restoration projects on Tribal lands. Santa Clara Pueblo received a Tribal Wildlife grant for nearly $200,000 for Rio Grande cutthroat trout restoration. The Pueblo is in the initial phases of project planning for restoring the Santa Clara Creek watershed. Nambe Pueblo has also expressed an interest in Rio Grande cutthroat trout restoration and is working in collaboration with USFS, the Service, Southwest Tribal Fisheries Commission (SWTFC), and NMDGF to formulate a restoration plan to restore Rio Grande cutthroat trout in the Nambe River watershed. The Jicarilla Apache Nation has also been involved in Rio Grande cutthroat trout restoration and plans to expand their restoration efforts to additional creeks on the reservation in the near future. The SWTFC, an organization composed of southwestern Native American tribes, has developed a Memorandum of Understanding with NMDGF to acquire Rio Grande cutthroat trout eggs for juvenile and adult production in support of tribal restoration Rio Grande cutthroat trout projects. Currently, the Memorandum is still awaiting approval by both participants. If successful, these actions would provide further conservation for Rio Grande cutthroat trout.

The Santa Fe National Forest, led by their fisheries biologist, has been very proactive about public education. They estimate that up until 2006 their ''Respect the Rio'' program directly reached over 9,300 people (Ferrell 2006, p. 16). They developed the Rio Grande Cutthroat Trout Life Cycle Game, which has traveled to classrooms, Earth Day events, and Kids' Fishing Day celebrations (Ferrell 2006, p. 15). The game has also been translated into Spanish to reach students who speak English as a second language. It is estimated that over 1,000 children and adults have played the game.

In New Mexico, a Rio Grande cutthroat trout Working Group meets monthly to discuss Rio Grande cutthroat trout conservation, projects, and volunteer opportunities, and to coordinate and communicate efforts among the participants. Regular members are NMDGF, the Service, Trout Unlimited, New Mexico Trout, and the USFS. The members are committed to Rio Grande cutthroat trout conservation.

One obstacle to fisheries managers in New Mexico has been the difficult process of approval for chemical treatment of streams. In August 2004, the New Mexico Game Commission voted to prohibit the use of piscicides in New Mexico (Patten *et al.* 2007, p. 102). This decision effectively terminated a project on Animas Creek, Gila National Forest, and has made stream restoration project approval difficult. Another obstacle to successful stream renovation is the stocking of nonnative trout by anglers into streams that have been treated to remove them (Japhet *et al.* 2007, p. 17). Although education and regulation may help, there is no known way to stop this illegal activity.

Summary of Factor E

Fisheries management is integral to the conservation of Rio Grande cutthroat trout. Although there are some risks associated with fisheries management, we conclude that the benefits outweigh the risks. We also conclude that the best scientific and commercial information available to us indicates that the threats facing Rio Grande cutthroat trout will be exacerbated by climate change. Continued management actions to connect fragmented populations are essential. However, at this time, it is not clear that management actions can outpace some of the projected effects of climate change.

Finding

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by Rio Grande cutthroat trout. We have reviewed information supplied to us by State and Federal agencies, peer-reviewed literature, comments from private citizens, and other unpublished documents. The information summarized in this status review includes substantial information that was not available at the time of our 2002 finding (67 FR 39936). On the basis of this review, we find that listing of Rio Grande cutthroat trout as threatened or endangered is warranted, due to a combination of population fragmentation, isolation, small population size, nonnative trout, drought, and fire. We anticipate these threats will be compounded by the projected effects of climate change. However, listing of the Rio Grande cutthroat trout is precluded at this time by pending proposals for other species with higher listing priorities and actions.

In the context of the Act, the term ''threatened species'' means any species (or subspecies or, for vertebrates, distinct population segments) that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. The term ''endangered species'' means any species that is in danger of extinction throughout all or a significant portion of its range. The Act does not indicate threshold levels of historic population size at which, as the population of a species declines, listing as either ''threatened'' or ''endangered'' becomes warranted. Instead, the principal considerations in the determination of whether or not a species warrants listing as a threatened or an endangered species under the Act are the threats that now confront the species and the probability that the species will persist into ''the foreseeable future.'' The Act does not define the term ''foreseeable future.'' However, we consider the ''foreseeable future'' to be 20 to 30 years, which equates to approximately 4 to 10 Rio Grande cutthroat trout generations, depending on the productivity of the environment. We find that this is both reasonable and appropriate for the present status review because it is long enough to take into account multi-generational dynamics of life-history and ecological adaptation, yet short enough to incorporate social and political change that affects species management.

Evidence shows that populations of Rio Grande cutthroat trout have been greatly reduced over the last 200 years. The range of Rio Grande cutthroat trout has contracted northward and populations are primarily restricted to high-elevation headwater streams. We attribute the decline in the distribution of Rio Grande cutthroat trout to habitat degradation and the introduction of nonnative sport fish into Rio Grande cutthroat trout habitat that began in the late 1800s. The wide distribution of rainbow trout and nonnative cutthroat trout have compromised Rio Grande cutthroat trout populations through competition, hybridization, and predation. These introduced fish have expanded and colonized new habitat and formed naturally reproducing populations that occupy the former, and in some cases current, range of Rio Grande cutthroat trout.

We find that populations we considered secure in 2002 suffered severe to moderate population declines. We considered 13 populations secure in 2002, and now we find that only 8 populations (5 identified in 2002, 3 new populations) would meet our definition of long-term persistence (over 2,500 fish, 9.6 km (6 mi) of occupied habitat, no nonnatives present). Although 97 additional conservation populations exist, they all are affected by one or more threats (e.g., small population size, short stream length, poor habitat quality, nonnative trout) that we consider significant enough to threaten their long-term survival. The overarching threat that magnifies the problems for each individual population is fragmentation. Over 90 percent of Rio Grande cutthroat trout populations exist in stream fragments. Consequently, recolonization of streams cannot occur after a natural disaster occurs and populations are much more susceptible to extirpation.

Because of the increases in air temperature that have already been documented in the Southwest, and other changes that have been documented in hydrology, fire patterns, and the life history of animals in the region, there is evidence that the effects of climate change are already occurring in the range of Rio Grande cutthroat trout. Every aspect of climate change we examined will likely have a negative effect on Rio Grande cutthroat trout. Rio Grande cutthroat trout populations are currently surviving with multiple stressors. Adding the effects of climate change on these populations may exacerbate the existing threats and stressors on the species.

There is documented commitment of agency personnel, tribes, and private landowners to continue conservation efforts for Rio Grande cutthroat trout. This is evidenced by the lists of accomplishments the States and agencies have provided to us. Both State and Federal agencies have been actively involved in Rio Grande cutthroat trout management. Several habitat restoration projects are in progress and several others are planned. It is too early to determine the level of success of current large watershed projects as they have not been fully completed and evaluated.

Listing Priority Number

In accordance with guidance we published on September 21, 1983, we assign a Listing Priority Number (LPN) to each candidate species (48 FR 43098). Such a priority ranking guidance system is required under section 4(h)(3) of the Act (16 U.S.C. 1533(h)(3)). Using this guidance, we assign each candidate an LPN of 1 to 12, depending on the magnitude of threats (high vs. moderate to low); immediacy of threats (imminent or non-imminent); and taxonomic status of the species, in order of priority (monotypic genus (i.e., a species that is the sole member of a genus), species, subspecies, distinct population segment, or significant portion of the range). The lower the listing priority number, the higher the listing priority (that is, a species with an LPN of 1 would have the highest listing priority).

Many of the threats to this subspecies could result in complete loss of a given population at any time (e.g., fire, disease, nonnative introgression). However, because there are many known conservation populations and because many populations are being actively managed, the threats to this subspecies as a whole are considered moderate.

An increase in average mean air temperature of just over 1 °C (2.5 °F) in Arizona and just under 1 °C (1.8 °F) in New Mexico since 1976 (Parmesan and Galbraith 2004, pp. 18, 19; State of New Mexico 2006, p. 5; Lenart 2007, p. 4) suggest that climate change is already occurring in the Southwest. Coldwater species like Rio Grande cutthroat trout are expected to be among the most sensitive species to climate change. Water temperatures in some Rio Grande cutthroat trout streams are already elevated beyond recommended temperatures for coldwater trout. At least 14 Rio Grande cutthroat trout streams either dried up or had populations negatively affected by the 2002 drought. Rio Grande cutthroat trout populations already face multiple stresses such as nonnative trout, fragmented habitat, and limited habitat. The additional effects of climate change are expected to cause population extirpations and population bottlenecks. Consequently, threats to this species are considered imminent. Therefore, based on the moderate magnitude and immediacy of threats, we have given this subspecies an LPN of 9.

Preclusion and Expeditious Progress

Preclusion is a function of the listing priority of a species in relation to the resources that are available and competing demands for those resources. Thus, in any given fiscal year (FY), multiple factors dictate whether it will be possible to undertake work on a proposed listing regulation or whether promulgation of such a proposal is warranted but precluded by higher priority listing actions.

The resources available for listing actions are determined through the annual Congressional appropriations process. The appropriation for the Listing Program is available to support work involving the following listing actions: proposed and final listing rules; 90-day and 12-month findings on petitions to add species to the Lists of Endangered and Threatened Wildlife and Plants (Lists) or to change the status of a species from threatened to endangered; annual determinations on prior ''warranted but precluded'' petition findings as required under section 4(b)(3)(C)(i) of the Act; proposed and final rules designating critical habitat; and litigation-related, administrative, and program management functions (including preparing and allocating budgets, responding to Congressional and public inquiries, and conducting public outreach regarding listing and critical habitat). The work involved in preparing various listing documents can be extensive and may include, but is not limited to: gathering and assessing the best scientific and commercial data available and conducting analyses used as the basis for our decisions; writing and publishing documents; and obtaining, reviewing, and evaluating public comments and peer review comments on proposed rules and incorporating relevant information into final rules. The number of listing actions that we can undertake in a given year also is influenced by the complexity of those listing actions; that is, more complex actions generally are more costly. For example, during the past several years, the cost (excluding publication costs) for preparing a 12-month finding, without a proposed rule, has ranged from approximately $11,000 for one species with a restricted range and involving a relatively uncomplicated analysis to $305,000 for another species that is wide-ranging and involving a complex analysis.

We cannot spend more than is appropriated for the Listing Program without violating the Anti-Deficiency Act (see 31 U.S.C. 1341(a)(1)(A)). In addition, in FY 1998 and for each fiscal year since then, Congress has placed a statutory cap on funds which may be expended for the Listing Program, equal to the amount expressly appropriated for that purpose in that fiscal year. This cap was designed to prevent funds appropriated for other functions under the Act (for example, recovery funds for removing species from the Lists), or for other Service programs, from being used for Listing Program actions (see House Report 105–163, 105th Congress, 1st Session, July 1, 1997).

Recognizing that designation of critical habitat for species already listed would consume most of the overall Listing Program appropriation, Congress also put a critical habitat subcap in place in FY 2002 and has retained it each subsequent year to ensure that some funds are available for other work in the Listing Program: ''The critical habitat designation subcap will ensure that some funding is available to address other listing activities'' (House Report No. 107–103, 107th Congress, 1st Session, June 19, 2001). In FY 2002 and each year until FY 2006, the Service has had to use virtually the entire critical habitat subcap to address court-mandated designations of critical habitat, and consequently none of the critical habitat subcap funds have been available for other listing activities. In FY 2007, we were able to use some of the critical habitat subcap funds to fund proposed listing determinations for high-priority candidate species; we expect to also be able to do this in FY 2008.

Thus, through the listing cap, the critical habitat subcap, and the amount of funds needed to address court-mandated critical habitat designations, Congress and the courts have in effect determined the amount of money available for other listing activities. Therefore, the funds in the listing cap, other than those needed to address court-mandated critical habitat for already listed species, set the limits on our determinations of preclusion and expeditious progress.

Congress also recognized that the availability of resources was the key element in deciding whether, when making a 12-month petition finding, we would prepare and issue a listing proposal or make a ''warranted but precluded'' finding for a given species. The Conference Report accompanying Public Law 97–304, which established the current statutory deadlines and the warranted-but-precluded finding, states (in a discussion on 90-day petition findings that by its own terms also covers 12-month findings) that the deadlines were ''not intended to allow the Secretary to delay commencing the rulemaking process for any reason other than that the existence of pending or imminent proposals to list species subject to a greater degree of threat would make allocation of resources to such a petition [that is, for a lower-ranking species] unwise.''

In FY 2008, expeditious progress is that amount of work that can be achieved with $8,206,940, which is the amount of money that Congress appropriated for the Listing Program at this time (that is, the portion of the Listing Program funding not related to critical habitat designations for species that are already listed). Our process is to make our determinations of preclusion on a nationwide basis to ensure that the species most in need of listing will be addressed first and also because we allocate our listing budget on a nationwide basis. The $8,206,940 for listing activities (that is, the portion of the Listing Program funding not related to critical habitat designations for species that already are listed) will be used to fund work in the following categories: Compliance with court orders and court-approved settlement agreements requiring that petition findings or listing determinations be completed by a specific date; section 4 (of the Act) listing actions with absolute statutory deadlines; essential litigation-related, administrative, and program management functions; and high-priority listing actions. The allocations for each specific listing action are identified in the Service's FY 2008 Draft Allocation Table (part of our administrative record). We are working on completing our allocation at this time. More funds are available in FY 2008 than in previous years to work on listing actions that are not the subject of court orders or court-approved settlement agreements.

We currently have more than 120 species with an LPN of 2. Therefore, we further rank the candidate species with an LPN of 2 by using the following extinction-risk type criteria: International Union for the Conservation of Nature and Natural Resources (IUCN) Red list status/rank, Heritage rank (provided by NatureServe), Heritage threat rank (provided by NatureServe), and species currently with fewer than 50 individuals, or 4 or fewer populations. Those species with the highest IUCN rank (critically endangered), the highest Heritage rank (G1), the highest Heritage threat rank (substantial, imminent threats), and currently with fewer than 50 individuals, or fewer than 4 populations, comprise a list of approximately 40 candidate species (''Top 40''). These 40 candidate species have the highest priority to receive funding to work on a proposed listing determination. To be more efficient in our listing process, as we work on proposed rules for these species in the next several years, we are preparing multi-species proposals when appropriate, and these may include species with lower priority if they overlap geographically or have the same threats as a species with an LPN of 2. In addition, available staff resources are also a factor in determining high-priority species provided with funding. Finally, proposed rules for reclassification of threatened species to endangered are lower priority, since the listing of the species already affords the protection of the Act and implementing regulations. We assigned the Rio Grande cutthroat trout an LPN of 9, based on our finding that the subspecies faces threats of moderate magnitude that are imminent.

As explained above, a determination that listing is warranted but precluded must also demonstrate that expeditious progress is being made to add or remove qualified species to and from the Lists of Endangered and Threatened Wildlife and Plants. (We note that we do not discuss specific actions taken on progress towards removing species from the Lists because that work is conducted using appropriations for our Recovery program, a separately budgeted component of the Endangered Species Program. As explained above in our description of the statutory cap on Listing Program funds, the Recovery Program funds and actions supported by them cannot be considered in determining expeditious progress made in the Listing Program.) As with our ''precluded'' finding, expeditious progress in adding qualified species to the Lists is a function of the resources available and the competing demands for those funds. Our expeditious progress in FY 2007 in the Listing Program, up to the date of making this finding for the Rio Grande cutthroat trout, included preparing and publishing the following determinations:

FY 2007 COMPLETED LISTING ACTIONS

Publication date	Title	Actions	FR pages
10/11/2006	Withdrawal of the Proposed Rule to List the Cow Head Tui Chub (*Gila biocolor vaccaceps*) as Endangered.	Final withdrawal, Threats eliminated.	71 FR 59700–59711.
10/11/2006	Revised 12-Month Finding for the Beaver Cave Beetle (*Pseudanophthalmus major*).	Notice of 12-month petition finding, Not warranted.	71 FR 59711–59714.
11/14/2006	12-Month Finding on a Petition to List the Island Marble Butterfly (*Euchloe ausonides insulanus*) as Threatened or Endangered.	Notice of 12-month petition finding, Not warranted.	71 FR 66292–66298.
11/14/2006	90-Day Finding for a Petition to List the Kennebec River Population of Anadromous Atlantic Salmon as Part of the Endangered Gulf Of Maine Distinct Population Segment.	Notice of 90-day petition finding, Substantial.	71 FR 66298–66301.
11/21/2006	90-Day Finding on a Petition To List the Columbian Sharp-Tailed Grouse as Threatened or Endangered.	Notice of 90-day petition finding, Not substantial.	71 FR 67318–67325.
12/5/2006	90-Day Finding on a Petition To List the Tricolored Blackbird as Threatened or Endangered.	Notice of 90-day petition finding, Not substantial.	71 FR 70483–70492.
12/6/2006	12-Month Finding on a Petition To List the Cerulean Warbler (*Dendroica cerulea*) as Threatened with Critical Habitat.	Notice of 12-month petition finding, Not warranted.	71 FR 70717–70733.
12/6/2006	90-Day Finding on a Petition To List the Upper Tidal Potomac River Population of the Northern Water Snake (*Nerodia sipedon*) as an Endangered Distinct Population Segment.	Notice of 90-day Petition Finding, Not substantial.	71 FR 70715–70717.
12/14/2006	90-Day Finding on a Petition to Remove the Uinta Basin Hookless Cactus From the List of Endangered and Threatened Plants; 90-Day Finding on a Petition To List the Pariette Cactus as Threatened or Endangered.	Notice of 5-year Review, Initiation. Notice of 90-day petition finding, Not substantial. Notice of 90-day petition finding, Substantial.	71 FR 75215–75220.
12/19/2006	Withdrawal of Proposed Rule to List *Penstemon grahamii* (Graham's beardtongue) as Threatened With Critical Habitat.	Notice of withdrawal, More abundant than believed, or diminished threats.	71 FR 76023–76035.
12/19/2006	90-Day Finding on Petitions to List the Mono Basin Area Population of the Greater Sage-Grouse as Threatened or Endangered.	Notice of 90-day petition finding, Not substantial.	71 FR 76057–76079.
1/9/2007	12-Month Petition Finding and Proposed Rule To List the Polar Bear (*Ursus maritimus*) as Threatened Throughout Its Range; Proposed Rule.	Notice of 12-month petition finding, Warranted. Proposed Listing, Threatened	72 FR 1063–1099.
1/10/2007	Endangered and Threatened Wildlife and Plants; Clarification of Significant Portion of the Range for the Contiguous United States Distinct Population Segment of the Canada Lynx.	Clarification of findings	72 FR 1186–1189.
1/12/2007	Withdrawal of Proposed Rule To List *Lepidium papilliferum* (Slickspot Peppergrass).	Notice of withdrawal, More abundant than believed, or diminished threats.	72 FR 1621–1644.
2/2/2007	12-Month Finding on a Petition To List the American Eel as Threatened or Endangered.	Notice of 12-month petition finding, Not warranted.	72 FR 4967–4997.
2/13/2007	90-Day Finding on a Petition To List the Jollyville Plateau Salamander as Endangered.	Notice of 90-day petition finding, Substantial.	72 FR 6699–6703.
2/13/2007	90-Day Finding on a Petition To List the San Felipe Gambusia as Threatened or Endangered.	Notice of 90-day petition finding, Not substantial.	72 FR 6703–6707.
2/14/2007	90-Day Finding on A Petition to List *Astragalus debequaeus* (DeBeque milkvetch) as Threatened or Endangered.	Notice 90-day petition finding, Not substantial.	72 FR 6998–7005.
2/21/2007	90-Day Finding on a Petition To Reclassify the Utah Prairie Dog From Threatened to Endangered and Initiation of a 5-Year Review.	Notice of 5-year Review, Initiation. Notice of 90-day petition finding, Not substantial.	72 FR 7843–7852.
3/8/2007	90-Day Finding on a Petition To List the Monongahela River Basin Population of the Longnose Sucker as Endangered.	Notice of 90-day petition finding, Not substantial.	72 FR 10477–10480.
3/29/2007	90-Day Finding on a Petition To List the Siskiyou Mountains Salamander and Scott Bar Salamander as Threatened or Endangered.	Notice 90-day petition finding, Substantial.	72 FR 14750–14759.

FY 2007 COMPLETED LISTING ACTIONS—Continued

Publication date	Title	Actions	FR pages
4/24/2007	Revised 12-Month Finding for Upper Missouri River Distinct Population Segment of Fluvial Arctic Grayling.	Notice of 12-month petition finding, Not warranted.	72 FR 20305–20314.
5/2/2007	12-Month Finding on a Petition to List the Sand Mountain Blue Butterfly (*Euphilotes pallescens* ssp. *arenamontana*) as Threatened or Endangered with Critical Habitat.	Notice of 12-month petition finding, Not warranted.	72 FR 24253–24263.
5/22/2007	Status of the Rio Grande Cutthroat Trout	Notice of Review	72 FR 28664–28665.
5/30/2007	90-Day Finding on a Petition To List the Mt. Charleston Blue Butterfly as Threatened or Endangered.	Notice of 90-day petition finding, Substantial.	72 FR 29933–29941.
6/5/2007	12-Month Finding on a Petition To List the Wolverine as Threatened or Endangered.	Notice of Review	72 FR 31048–31049.
6/6/2007	90-Day Finding on a Petition To List the Yellow-Billed Loon as Threatened or Endangered.	Notice 90-day Petition Finding, Substantial.	72 FR 31256–31264.
6/13/2007	12-Month Finding for a Petition To List the Colorado River Cutthroat Trout as Threatened or Endangered.	Notice 12-month petition finding, Not warranted.	72 FR 32589–32605.
6/25/2007	12-Month Finding on a Petition To List the Sierra Nevada Distinct Population Segment of the Mountain Yellow-Legged Frog (*Rana muscosa*).	Notice amended 12-month petition finding, Warranted but precluded.	72 FR 34657–34661.
7/5/2007	12-Month Finding on a Petition To List the Casey's June Beetle (*Dinacoma caseyi*) as Endangered With Critical Habitat.	Notice 12-month petition finding, Warranted but precluded.	72 FR 36635–36646.
8/15/2007	90-Day Finding on a Petition To List the Yellowstone National Park Bison Herd as Endangered.	Notice 90-day Petition Finding, Not substantial.	72 FR 45717–45722.
08/16/2007	90-Day Finding on a Petition To List *Astragalus anserinus* (Goose Creek milk-vetch) as Threatened or Endangered.	Notice 90-day Petition Finding, Substantial.	72 FR 46023–46030.
8/28/2007	12-Month Finding on a Petition To List the Gunnison's Prairie Dog as Threatened or Endangered.	Notice of Review	72 FR 49245–49246.
9/11/2007	90-Day Finding on a Petition To List Kenk's Amphipod, Virginia Well Amphipod, and the Copepod *Acanthocyclops columbiensis* as Endangered.	Notice 90-day Petition Finding, Not substantial.	72 FR 51766–51770.
9/18/2007	12-month Finding on a Petition To List *Sclerocactus brevispinus* (Pariette cactus) as an Endangered or Threatened Species; Taxonomic Change From *Sclerocactus glaucus* to *Sclerocactus brevispinus, S. glaucus,* and *S. wetlandicus*.	Notice 12-month petition finding for uplisting, Warranted but precluded.	72 FR 53211–53222.

In FY 2007, we provided funds to work on proposed listing determinations for the following high-priority species: 3 southeastern aquatic species (Georgia pigtoe, interrupted rocksnail, and rough hornsnail), 2 Oahu plants *(Doryopteris takeuchii, Melicope hiiakae),* 31 Kauai species (Kauai creeper, *Drosophila attigua, Astelia waialealae, Canavalia napaliensis, Chamaesyce eleanoriae, Chamaesyce remyi* var. *kauaiensis, Chamaesyce remyi* var. *remyi, Charpentiera densiflora, Cyanea eleeleensis, Cyanea kuhihewa, Cyrtandra oenobarba, Dubautia imbricata* ssp. *imbricata, Dubautia plantaginea* ssp. *magnifolia, Dubautia waialealae, Geranium kauaiense, Keysseria erici, Keysseria helenae, Labordia helleri, Labordia pumila, Lysimachia daphnoides, Melicope degeneri, Melicope paniculata, Melicope puberula, Myrsine mezii, Pittosporum napaliense, Platydesma rostrata, Pritchardia hardyi, Psychotria grandiflora, Psychotria hobdyi, Schiedea attenuata, Stenogyne kealiae*), 4 Hawaiian damselflies *(Megalagrion nesiotes, Megalagrion leptodemas, Megalagrion oceanicum, Megalagrion pacificum),* and one Hawaiian plant (*Phyllostegia hispida* (no common name)). In FY 2008, we are continuing to work on these listing proposals (we are now including an additional 17 species in the Kauai species proposed listing determination package). In addition, we are continuing to work on several other determinations listed below, which we funded in FY 2007 and are scheduled to complete in FY 2008.

ACTIONS FUNDED IN FY 2007 THAT HAVE YET TO BE COMPLETED

Species	Action
Actions Subject to Court Order/Settlement Agreement:	
Western sage grouse	90-day petition finding (remand).
Actions with Statutory Deadlines:	
Polar bear	Final listing determination.
Ozark chinquapin	90-day petition finding.
Tucson shovel-nosed snake	90-day petition finding.
Gopher tortoise—Florida population	90-day petition finding.
Sacramento valley tiger beetle	90-day petition finding.
Eagle lake trout	90-day petition finding.
Smooth billed ani	90-day petition finding.
Mojave ground squirrel	90-day petition finding.
Gopher Tortoise—eastern population	90-day petition finding.
Bay Springs salamander	90-day petition finding.
Tehachapi slender salamander	90-day petition finding.

ACTIONS FUNDED IN FY 2007 THAT HAVE YET TO BE COMPLETED—Continued

Species	Action
Evening primrose	90-day petition finding.
Northern leopard frog	90-day petition finding.
Cactus ferruginous pygmy owl	90-day petition finding.

Our expeditious progress so far in FY 2008 in the Listing Program, includes preparing and publishing the following:

FY 2008 COMPLETED LISTING ACTIONS

Publication date	Title	Actions	FR pages
10/09/2007	90-Day Finding on a Petition To List the Black-Footed Albatross (Phoebastria nigripes) as Threatened or Endangered.	Notice of 90-day Petition Finding, Substantial.	72 FR 57278–57283.
10/09/2007	90-Day Finding on a Petition To List the Giant Palouse Earthworm as Threatened or Endangered.	Notice of 90-day Petition Finding, Not Substantial.	72 FR 57273–57276.
10/23/2007	90-Day Finding on a Petition To List the Mountain Whitefish (Prosopium williamsoni) in the Big Lost River, ID, as Threatened or Endangered.	Notice of 90-day Petition Finding, Not Substantial.	72 FR 59983–59989.
10/23/2007	90-Day Finding on a Petition To List the Summer-Run Kokanee Population in Issaquah Creek, WA, as Threatened or Endangered.	Notice of 90-day Petition Finding, Not substantial.	72 FR 59979–59983.
11/08/2007	Response to Court on Significant Portion of the Range, and Evaluation of Distinct Population Segments, for the Queen Charlotte Goshawk.	Response to Court	72 FR 63123–63140.
12/13/2007	12-Month Finding on a Petition To List the Jollyville Plateau Salamander (Eurycea tonkawae) as Endangered With Critical Habitat.	Notice of 12-month Petition Finding, Warranted but Precluded.	72 FR 71039–71054.
1/08/2008	90-Day Finding on a Petition To List the Pygmy Rabbit (Brachylagus idahoensis) as Threatened or Endangered.	Notice of 90-day Petition Finding, Substantial.	73 FR 1312–1313.
1/10/2008	90-Day Finding on Petition To List the Amargosa River Population of the Mojave Fringe-Toed Lizard (Uma scoparia) as Threatened or Endangered With Critical Habitat.	Notice of 90-day Petition Finding, Substantial.	73 FR 1855–1861.
1/24/2008	12-Month Finding on a Petition To List the Siskiyou Mountains Salamander (Plethodon stormi) and Scott Bar Salamander (Plethodon asupak) as Threatened or Endangered.	Notice of 12-month Petition Finding, Not Warranted.	73 FR 4379–4418.
2/05/2008	12-Month Finding on a Petition To List the Gunnison's Prairie Dog as Threatened or Endangered.	Notice of 12-month Petition Finding, Warranted.	73 FR 6660–6684.
2/07/2008	12-Month Finding on a Petition To List the Bonneville Cutthroat Trout (Oncorhynchus clarki utah) as Threatened or Endangered.	Notice of Review	73 FR 7236–7237.
2/19/2008	Listing Phyllostegia hispida (No Common Name) as Endangered Throughout Its Range.	Proposed Listing, Endangered	73 FR 9078–9085.
2/26/2008	Initiation of Status Review for the Greater Sage-Grouse (Centrocercus urophasianus) as Threatened or Endangered.	Notice of Review	73 FR 10218–10219.
3/11/2008	12-Month Finding on a Petition To List the North American Wolverine as Endangered or Threatened.	Notice of 12-month Petition Finding, Not Warranted.	73 FR 12929–12941.
3/20/2008	90-Day Finding on a Petition To List the U.S. Population of Coaster Brook Trout (Salvelinus fontinalis) as Endangered.	Notice of 90-day Petition Finding, Substantial.	73 FR 14950–14955.

Our expeditious progress also includes work on listing actions, which we are funding in FY 2008. These actions are listed below. We are conducting work on those actions in the top section of the table under a deadline set by a court. Actions in the middle section of the table are being conducted to meet statutory timelines, that is, timelines required under the Act. Actions in the bottom section of the table are high priority listing actions, which include at least one or more species with an LPN of 2, available staff resources, and, when appropriate, species with a lower priority if they overlap geographically or have the same threats as the species with the high priority.

ACTIONS FUNDED IN FY 2008 THAT HAVE YET TO BE COMPLETED

Species	Action
Actions Subject to Court Order/Settlement Agreement:	
Bonneville cutthroat trout	12-month petition finding (remand).
Mexican garter snake	12-month petition finding (remand).
Actions with Statutory Deadlines:	
Polar bear	Final listing determination.

ACTIONS FUNDED IN FY 2008 THAT HAVE YET TO BE COMPLETED—Continued

Species	Action
Phyllostegia hispida	Final listing.
Yellow-billed loon	12-month petition finding.
Black-footed albatross	12-month petition finding.
Mount Charleston blue butterfly	12-month petition finding.
Goose Creek milk-vetch	12-month petition finding.
Mojave fringe-toed lizard	12-month petition finding.
White-tailed prairie dog	12-month petition finding.
Pygmy rabbit (rangewide)	12-month petition finding.
Delta smelt (uplisting)	90-day petition finding.
Mono Basin sage grouse (vol. remand)	90-day petition finding.
Ashy storm petrel	90-day petition finding.
Longfin smelt—San Fran. Bay population	90-day petition finding.
Black-tailed prairie dog	90-day petition finding.
Lynx (include New Mexico in listing)	90-day petition finding.
Wyoming pocket gopher	90-day petition finding.
Llanero coqui	90-day petition finding.
Least chub	90-day petition finding.
American pika	90-day petition finding.
Dusky tree vole	90-day petition finding.
Sacramento Mts. checkerspot butterfly	90-day petition finding.
Kokanee—Lake Sammamish population	90-day petition finding.
206 species	90-day petition finding.
475 Southwestern species	90-day petition finding.
High Priority Listing Actions:	
48 Kauai species [1]	Proposed listing.
21 Kauai species	Proposed listing.
11 packages of high-priority candidate species	Proposed listing.
Flatwoods salamander (taxonomic revision)	Proposed listing.

[1] Funds used for this listing action were also provided in FY 2007.

We have endeavored to make our listing actions as efficient and timely as possible, given the requirements of the relevant law and regulations, and constraints relating to workload and personnel. We are continually considering ways to streamline processes or achieve economies of scale, such as by batching related actions together. Given our limited budget for implementing section 4 of the Act, these actions described above collectively constitute expeditious progress.

We will list the Rio Grande cutthroat trout as threatened or endangered when funding is available for discretionary listing actions. We intend any listing action for the Rio Grande cutthroat trout to be as accurate as possible. Therefore, we will continue to accept additional information and comments on the status of and threats to this subspecies from all concerned governmental agencies, the scientific community, industry, or any other interested party concerning this finding. If an emergency situation develops with this subspecies that warrants an emergency listing, we will act immediately to provide additional protection.

References Cited

A complete list of all references cited in this document is available from the New Mexico Ecological Services Field Office (see **ADDRESSES** section).

Author

The primary author of this notice is the staff of the Albuquerque Ecological Services Field Office, 2105 Osuna Road NE., Albuquerque, NM 87113.

Authority: The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: April 30, 2008.

Kenneth Stansell,

Director, Fish and Wildlife Service.

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