PETITION TO LIST THE
Rio Grande Sucker (*Catostomus plebeius*)
UNDER THE ENDANGERED SPECIES ACT

Rio Grande sucker (*Catostomus plebeius*). Photo: Colorado Department of Natural Resources.

Petition Submitted to the U.S. Secretary of the Interior
Acting through the U.S. Fish and Wildlife Service

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September 29, 2014

WILDEARTH GUARDIANS
A FORCE FOR NATURE
25 YEARS

INTRODUCTION

Pursuant to Section 4(b) of the Endangered Species Act (ESA), 16 U.S.C. § 1533(b), Section 553(3) of the Administrative Procedures Act, 5 U.S.C. § 533(e), and 50 C.F.R. § 424.14(a), WildEarth Guardians requests that the U.S. Fish and Wildlife Service (Service) list the Rio Grande sucker (*Catostomus plebeius*) as "endangered" or "threatened" throughout its entire range under the ESA. Additionally, WildEarth Guardians requests that the Service designate critical habitat for the species in occupied and suitable unoccupied U.S. habitat as appropriate and concurrent with the final ESA listing.

Three of the cornerstone native fish of the Rio Grande—the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), Rio Grande chub (*Gila pandora*), and Rio Grande sucker—are all imperiled. These three species co-evolved to fill different niches in the Rio Grande and its tributaries. "The Rio Grande sucker is primarily algivorous. It co-evolved with the Rio Grande cutthroat trout… and the Rio Grande chub…, which filled the trophic levels of piscivore and insectivore, respectively" (Rees and Miller 2005 at 15, *internal citations omitted; see also* Rees et al. 2005 at 14). As dams, diversions, and human land uses including livestock grazing and timber harvest have altered the Rio Grande, these species have all declined and are now deemed imperiled (*see* Rinne and Platania 1995 *and* Calamusso 2005 *for general discussion*). The Rio Grande cutthroat trout is currently a candidate for listing under the ESA, and has been since 2008 (USFWS 2008, *entire*; USFWS 2012, *entire*). WildEarth Guardians petitioned the Rio Grande chub for listing in 2013. With this petition, we request that the Service also protect the Rio Grande sucker under the ESA.

The Rio Grande sucker occurs in the Rio Grande and its tributaries in southern Colorado, New Mexico, and several states in Mexico. Rio Grande sucker populations are declining, mainly due to habitat loss and degradation. Runoff and sediment loads from logging, large-scale agricultural practices, and livestock grazing, among other factors, have decreased habitat quantity and quality for the sucker. Diversion of water for agriculture reduces stream flows and destroys habitat. Dams and diversions are fragmenting populations. The sucker is also subjected to competition from introduced fish species, in particular the white sucker (*Catostomus commersonii*). Climate change is projected to exacerbate current threats as well as further tax the already-strained river. The state of Colorado recognized the precarious position of the Rio Grande sucker by listing it as "endangered" in 1993 and published a recovery plan for the species in 1994. Unfortunately, the state listing did not stem the species' decline.

To ensure protection for the Rio Grande sucker, WildEarth Guardians seeks its listing as "threatened" or "endangered" under the ESA. Listing will afford the sucker critical habitat designation, a recovery plan, and the stringent federal protection it needs to survive. Designating the Rio Grande sucker as "endangered" or "threatened" would also benefit its remaining habitat, which is under threat from continued human uses of the land and water.

ENDANGERED SPECIES ACT AND IMPLEMENTING REGULATIONS

The ESA, 16 U.S.C. §§ 1531-1544, was enacted in 1973 "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved,

[and] to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). The protections of the ESA only apply to species that are listed as endangered or threatened according to the provisions of the statute. The ESA delegates authority to determine whether a species should be listed as endangered or threatened to the Secretary of Interior, who in turn delegated authority to the Director of the U.S. Fish & Wildlife Service. As defined in the ESA, an "endangered" species is one that is "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6); *see also* 16 U.S.C. § 533(a)(1). A "threatened species" is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20). The Service must evaluate whether a species is threatened or endangered as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

A. The present or threatened destruction, modification, or curtailment of its habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. The inadequacy of existing regulatory mechanisms; or
E. Other natural or manmade factors affecting its continued existence.

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing. 50 C.F.R. § 424.11.

The Service is required to make these listing determinations "solely on the basis of the best scientific and commercial data available to [it] after conducting a review of the status of the species and after taking into account" existing efforts to protect the species without reference to the possible economic or other impacts of such a determination. 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). "The obvious purpose of [this requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 520 U.S. 154, 175 (1997). "Reliance upon the best available scientific data, as opposed to requiring absolute scientific certainty, 'is in keeping with congressional intent' that an agency 'take preventive measures' *before* a species is 'conclusively' headed for extinction." *Ctr. for Biological Diversity v. Lohn*, 296 F. Supp. 2d 1223, 1236 (W.D. Wash. 2003) (emphasis in original).

In making a listing determination, the Secretary must give consideration to species which have been "identified as in danger of extinction, or likely to become so within the foreseeable future, by any State agency or by any agency of a foreign nation that is responsible for the conservation of fish or wildlife or plants." 16 U.S.C. § 1533(b)(1)(B)(ii); *see also* 50 C.F.R. § 424.11(e) (the fact that a species has been identified by any State agency as being in danger of extinction may constitute evidence that the species is endangered or threatened). Listing may be done at the initiative of the Secretary or in response to a petition. 16 U.S.C. § 1533(b)(3)(A).

After receiving a petition to list a species, the Secretary is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). Such a finding is termed a "90-day finding." A "positive" 90-day finding leads to a status review and a determination whether the species will be listed, to be completed within twelve months. 16 U.S.C. §1533(b)(3)(B). A "negative" initial finding ends the listing process, and the ESA authorizes judicial review of such a finding. 16 U.S.C. § 1533(b)(3)(C)(ii). The applicable regulations define "substantial information," for purposes of consideration of petitions, as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1).

The regulations further specify four factors to guide the Service's consideration on whether a particular listing petition provides "substantial" information:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;
iii. Provides information regarding the status of the species over all or significant portion of its range; and
iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps.

50 C.F.R. §§ 424.14(b)(2)(i)-(iv).

Both the language of the regulation itself (by setting the "reasonable person" standard for substantial information) and the relevant case law underscore the point that the ESA does not require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004); *see also Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms"). Rather, the courts have held that the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species may be warranted" ~~(e~~Morgenweck, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A)); *see also Ctr. for Biological Diversity v. Kempthorne*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007) (holding that in issuing negative 90-day findings for two species of salamander, the Service "once again" erroneously applied "a more stringent standard" than that of the reasonable person).

CLASSIFICATION AND NOMENCLATURE

Common name. Common names for *Catostomus plebeius* (Baird and Girard 1854) include Rio Grande sucker, Rio Grande mountain-sucker, or matalote del bravo. We refer to this species as the "Rio Grande sucker" or "sucker" throughout this petition.

Taxonomy. The sucker was originally described as a distinct species (*Catostomus plebeius*) by Baird and Girard in 1854 based on specimens from the Mimbres River, New Mexico. Prior to being placed in the genus *Catostomus*, the sucker was classified as *Pantosteus* and retains that ranking as a subgenus due to the well-developed scraping edges on its jaw (Rees and Miller 2005 at 8). It is referred to as *Pantosteus plebeius* in some of the references cited in this petition. It was also described by Cope and Yarrow under the name *Pantosteus jarovii* (Jordan 1891 at 19; Cope and Yarrow 1875 at 674-675) or *Minomus jarovii* (Smith et al. 1983 at 37). The species' taxonomic classification is shown in Table 1.

Table 1. Taxonomic classification for *Catostomus plebeius* (BISONM 2013 at 1)

Kingdom	Animalia
Phylum	Chordata
Class	Actinopterygii
Order	Cypriniformes
Family	Catostomidae
Genus	*Catostomus*
Species	*plebeius*

SPECIES DESCRIPTION

The sucker's body is terete and dorsal-ventrally depressed. The standard length (SL) of the species' caudal peduncle depth is 10.5 millimeters (mm); predorsal scales number from 40 to 55 but usually less than 50; lateral line scales number from 79 to 92; scale above the lateral line number from 14 to 15 (Rees and Miller 2005 at 8); and vertebrae number from 42 to 46 (Snyder 1979 at 60). The sucker's back and sides are brownish-green to dusky-brown with darker blotches, and it has a pale abdomen, often with mottling on its sides (Sublette 1990 at 212; Figure 1). The lining of the sucker's body cavity (peritoneum) is silvery and dusky with scattered melanophores, and its caudal fin is pigmented (Smith 1966 at 50).

The species' mouth is ventral with a broad snout and uniformly papillose lips. Its lower lip is thick and fleshy with a deep median cleft exhibiting two or three rows of papillae between the base and lower jaw (Figure 2). Its gill rakers are also papillose, with the outer row often having less than 25 and inner row less than 35 papillae (Sublette 1990 at 212; *see also* Smith et al. 1983 at 46). The sucker's pharyngeal teeth are in a single row of 22-23, are nominally bifurcated, and decrease in size toward the dorsal apex (Sublette 1990 at 212-213).

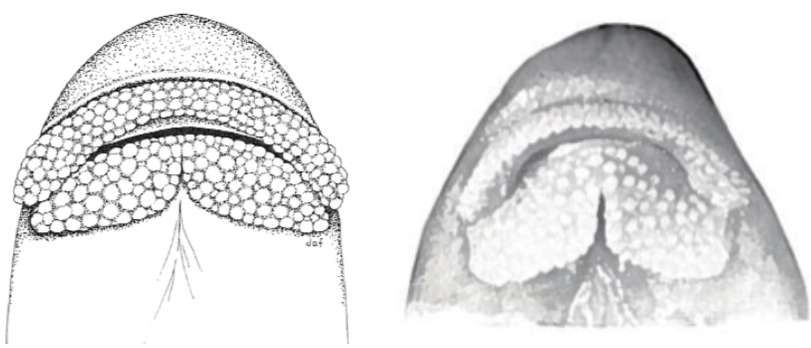
The dorsal fin is triangular and short with nine rays; the pectorals are bluntly pointed with no axillary process and 14 to 15 rays; the pelvic fins are oval with nine rays; the anal fin is elongated with seven rays, extending posteriorly to the caudal fin; and the caudal fin is deeply forked with bluntly pointed lobes. *Id*. at 213.

> There is considerable confusion in the natural history literature regarding the maximum body size of *C. plebeius*. For example, Koster (1957) wrote that adults "may reach a foot in length," while Sublette et al. (1990) reported a maximum body size for *C. plebeius* of 260 mm SL. Neither museum records nor locality data were reported for these values, making assessment of their validity difficult. Furthermore, in his extensive analysis of the subgenus *Pantosteus*, Smith (1966) reported an approximate size of 160 mm SL. More recent reports from the upper Rio Grande indicate a maximum total length of 200 to 209

> mm, or approximately 170 to 178 mm SL. If earlier reports of larger body size are accurate and reflect historical sizes of upper Rio Grande populations, this raises the possibility that the presence of *C. commersoni* depresses maximum size of *C. plebeius* [*see* Factor E, "Competition with introduced species," *infra*]. However, recent collections of *C. plebeius* from the uninvaded Rio Guadalupe (a Jemez River tributary) do not support this hypothesis, because maximum sizes are <175 mm SL. (McPhee 2007 at 22, *some internal citations omitted*)

Figure 1. Rio Grande sucker (© Joseph Tomelleri, Rees and Miller 2005 at Cover).

Figure 2. Rio Grande sucker jaws and lips, ventral view (*drawing:* Sublette et al. 1990 at 212; *photograph:* Smith 1966, Plate I).



LIFE HISTORY

Reproduction and maturity. Rio Grande suckers mature at a length of 60 to 80 mm for males, and 70 to 90 mm for females (Smith 1966 at 52). Some may mature at one year of age, but most do not mature until their second year. *Id*. "However, studies in Jemez Creek, New Mexico indicated that males and females did not become sexually mature until they were 3 years old" (Rees and Miller 2005 at 13). Maturation rate is influence by water temperature and food resources. *Id*. The oldest males captured were age six (average SL was 134 mm), and the oldest females were age seven (average SL was 169 mm) (Rees and Miller 2005 at 8).

Spawning occurs over areas of clean gravel substrate (medium gravel (8-16 mm) (Calamusso and Rinne 1996 at 158)) in the spring, and in some areas again in the fall (Koster 1957 at 46). The sucker's spawning period is influenced by thermal regime and latitude.

> Temperature is the controlling factor [in Rio Grande sucker breeding biology] as indicated by latitudinal and elevation differences in spawning time. Spawning begins in February in the southern portion of the species range and occurs progressively later northward. Rio Grande sucker were found spawning in Animas Creek, Sierra County, NM, in February when water temperature reached 9°C [48.2°F] and in June in streams on the Santa Fe National Forest when water temperature also reached 9°C. Rinne (1995 [at 239]) reported spawning in the Rio de las Vacas peaking in June during the declining spring flows, and Rausch (1963) found the species spawning in the Jemez River in May. (Calamusso 2005 at 160, *some internal citations omitted*)

"Rio Grande sucker in Colorado have been observed in spawning condition from late March through late May (Rees and Miller 2005 at 14, *citing* Zuckerman and Langlois 1990). Rio Grande suckers in Hot Creek and McIntyre Springs in Colorado spawned when water temperatures were between 11 and 16°C (51.8 and 60.8°F). *Id*. In Hot Creek, they have "been observed in spawning condition and coloration in the fall (November). The altered thermal regime that results from the influence of springs in Hot Creek may result in the observed reproductive condition of fish in November. *Id*., *internal citations omitted*.

"Spawning condition is manifested by tuberculation and color changes in both sexes. These features are more detectable in males, generally on the head and gular regions (Rinne 1995 at 240). "During the breeding season, the males develop a more striking coloration. Along each side they then have a jet black band that is paralleled by a golden stripe above and a red one below" (Koster 1957 at 46; *see also* Page and Burr 2011, Plate 21). Female Rio Grande suckers over 100 mm (3.9 inches) in length produced an average of 2,035 ova (Rinne 1995 at 239).

"To date, most of the information on the genus has been qualitative and descriptive... Such a lack of biological studies results, in part, from the erroneous concept that suckers are 'rough fish' and are 'harmful' to other species, especially trout. Indeed, suckers more probably are a source of food for introduced and native salmonid species" (Rinne 1995 at 240, *internal citations omitted*).

Diet. Rio Grande suckers are omnivores with "a cartilaginous ridge on upper and lower jaws for scraping plant material from substrates and an elongated intestine" to facilitate plant digestion (Swift-Miller et al. 1999a at 148-149). Periphyton (the microfloral community living on surfaces of objects submersed in water (*Id*. at 151)) and invertebrates are their primary diet components (Smith 1966 at 52; White 1972 at 27-29; Sublette et al. 1990 at 213). The findings of stomach contents from several populations included algae, periphyton, aquatic and benthic macroinvertebrates, larval fish, organic detritus, fingernail clams, and sand and silt (Rees and Miller 2005 at 13; Langlois et al. 1994 at 6). Large suckers feed mainly in fast, rocky riffles but also forage in rocky pools (Langlois et al. 1994 at 6).

Figure 3. The Rio Grande Basin (USGS National Stream Quality Accounting Network, water.usgs.gov/nasqan/docs/riogrndfact/riogrndfactsheet.html)

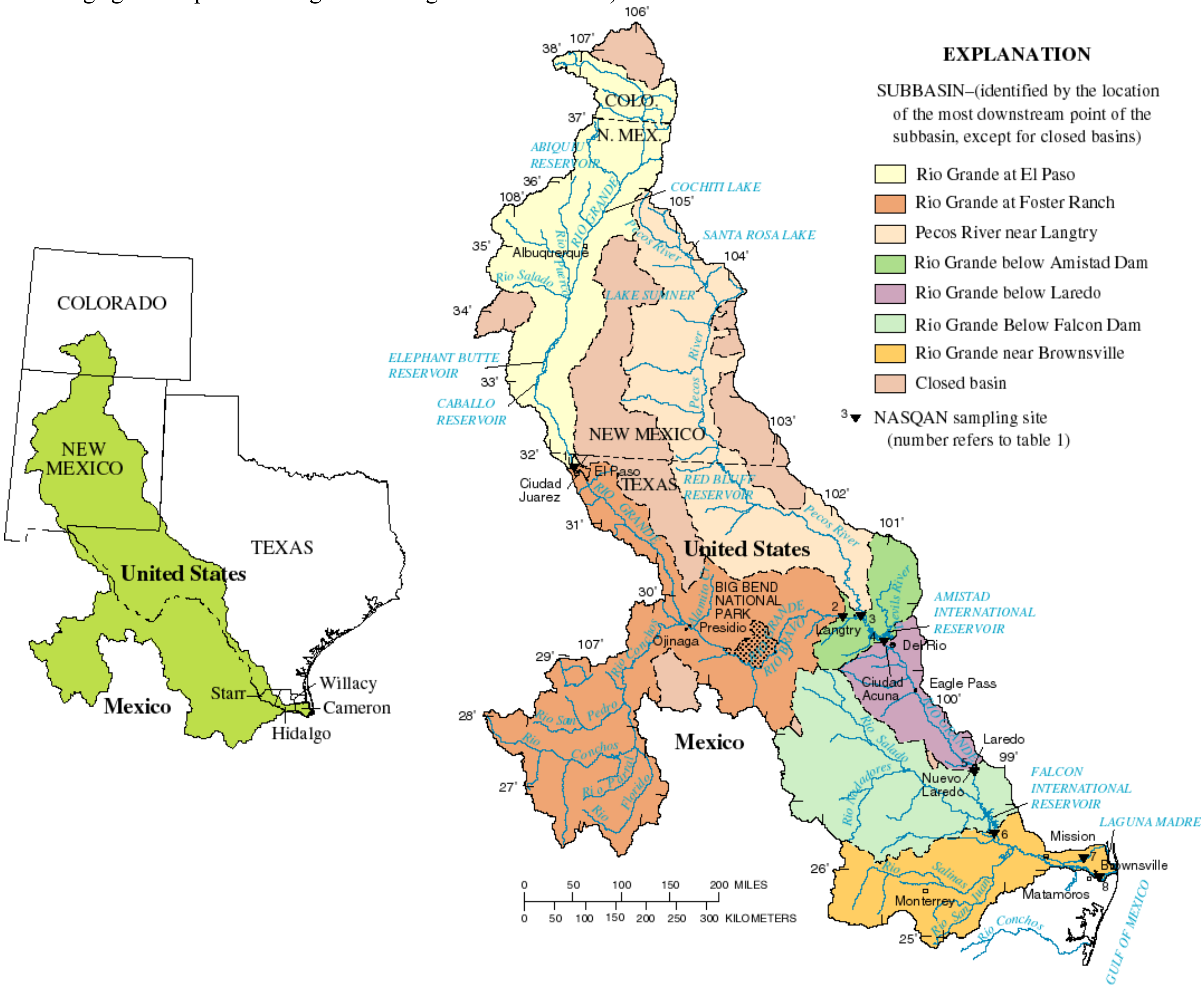


Figure 4. Early distribution map of the Rio Grande sucker, *circa* 1980 (Langlois et al. 2005 at 5, *citing* Lee et al. 1980).

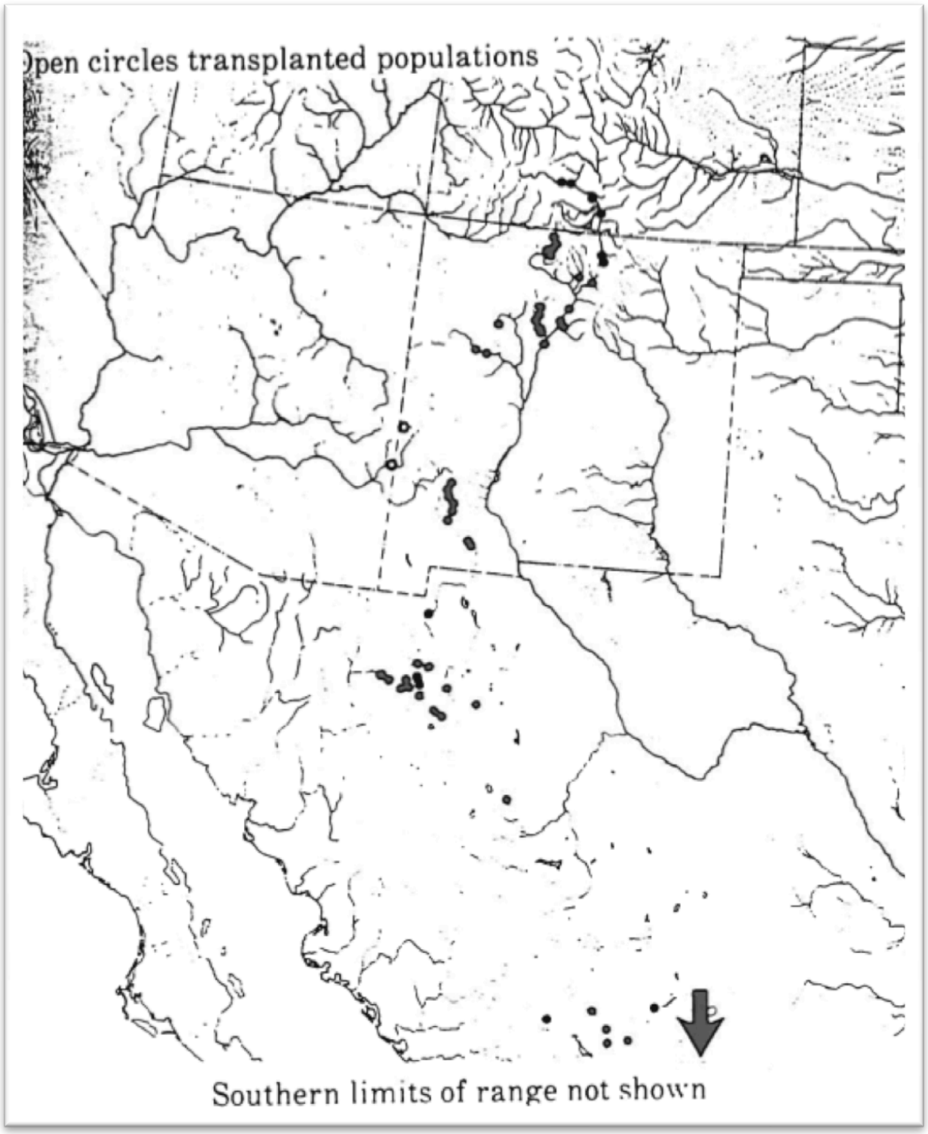
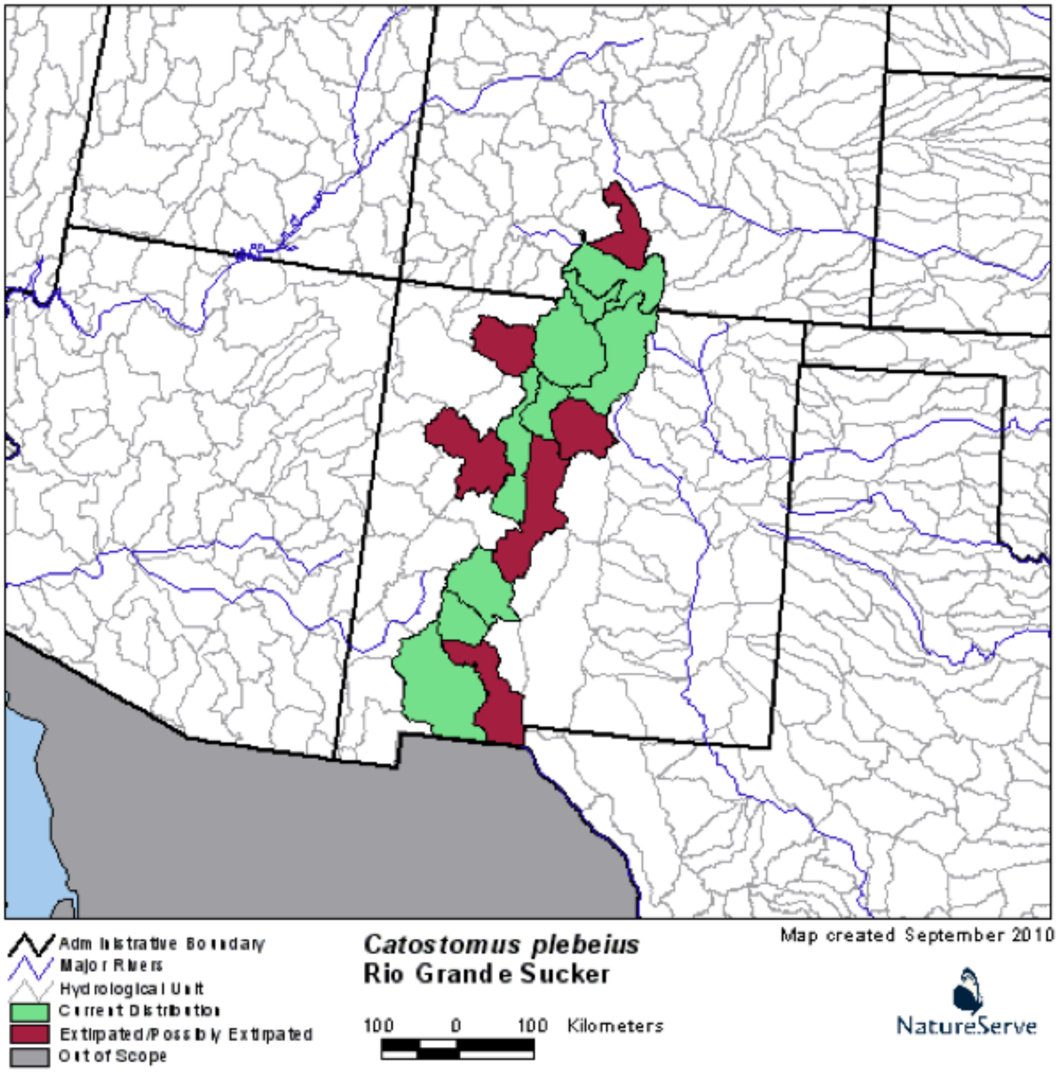


Figure 5. U.S. distribution of the Rio Grande sucker by watershed (Hammerson and Clausen 2013 at 5).



Habitat Requirements

"Rio Grande sucker are found in small to large, middle elevation streams with gravel/cobble/rubble substrates. They can also be found in back-water, beaver ponds, and pools proximate to riffles" (Calamusso and Rinne 1996 at 158). Rio Grande suckers require low gradient (<3.5 percent), low velocity stream mileage (Calamusso et al. 2002 at 182) with clean gravels, though they tolerate low gravel embeddedness. Aquatic vegetation, overstory canopy, and instream woody debris correlate with sucker presence, and they also inhabit clear pools in stream bends that were formerly beaver ponds (Langlois et al. 1994 at 6). "Distribution information from the Carson and Santa Fe national forests (New Mexico) suggested that this species was rarely collected at an elevation above 2,743 m (9,000 ft.)" (Rees and Miller 2005 at 9). Rio Grande suckers are rarely found in waters with heavy silt loads, and appear to be negatively affected by stream erosion and sedimentation (Swift-Miller 1999b at 47), likely because silt deposition buries periphyton, their primary food source (*see* Factor A, *infra*).

GEOGRAPHIC DISTRIBUTION: HISTORIC AND CURRENT

Rio Grande suckers were historically common in many areas of the Rio Grande Basin (Figure 3) from Colorado into Mexico. They have become particularly restricted at the northern edge of their historic range, a pattern common to many imperiled North American fish species: "Williams et al. (1989) list 397 fish taxa (species or subspecies) as either having or needing protection throughout or in some portion of their range… Many of these fishes are listed by states on the periphery of their range but not by states more centrally located, an indication that increasingly, the ranges of fishes are shrinking to include only presumed 'optimal' habitat" (Moyle and Leidy 1992 at 133).

Colorado. The distribution and abundance of the Rio Grande sucker has been significantly reduced from historic populations in Colorado. Historical records indicate that the species was abundant within its (relatively small) Colorado range and that its distribution included both small tributaries and large rivers (Rees and Miller 2005 at 9).

> While specific historical distribution and population information is not available, it is likely that Rio Grande suckers have always been confined to a relatively small portion of Colorado (i.e., Rio Grande Basin). Within this basin, Rio Grande sucker distribution was likely further controlled by spatial (e.g., temperature, gradient) restrictions… In Colorado, a synthesis of available information would suggest that historic Rio Grande sucker populations were mostly concentrated in low gradient streams of the San Luis Valley, with some limited distribution in mountain streams. This equates to a very localized distribution in [U.S. Forest Service] Region 2 that is associated with only the Rio Grande National Forest. The current distribution of this species in Region 2, including natural and introduced populations, is restricted to several Hydrologic Unit Boundary (HUB)[1] units in the southern portion of Colorado.

Id., *internal citations omitted; see* Figures 5 and 6.

When Rio Grande suckers were surveyed in Colorado in the 1980s, populations were found in only two locations in Conejos County: Hot Creek and McIntyre Springs (Rees and Miller 2005 at 9, *citing* Zuckerman and Langlois 1990). In 1994, surveys determined that the McIntyre Springs population had been extirpated (Rees and Miller 2005 at 9); it declined "from an abundant, stable population to extirpated in less than 10 years" (Swift-Miller 2001 at 2). "Habitat degradation and interactions with nonnative species are considered potential causes for this decline" (Swift 1996 at 6). The remaining Hot Creek population consisted of approximately 1,500 individuals concentrated in a 6 km (3.7 m) reach in the Hot Creek State Wildlife Area, immediately downstream from the Rio Grande National Forest boundary. *Id.* at 9-12.

Since 1995, Rio Grande suckers have been reintroduced into seven aquatic systems; five of those populations are within the Rio Grande National Forest. Successful reproduction was only confirmed in three streams (Rees and Miller 2005 at 12). "The Rio Grande sucker continues to

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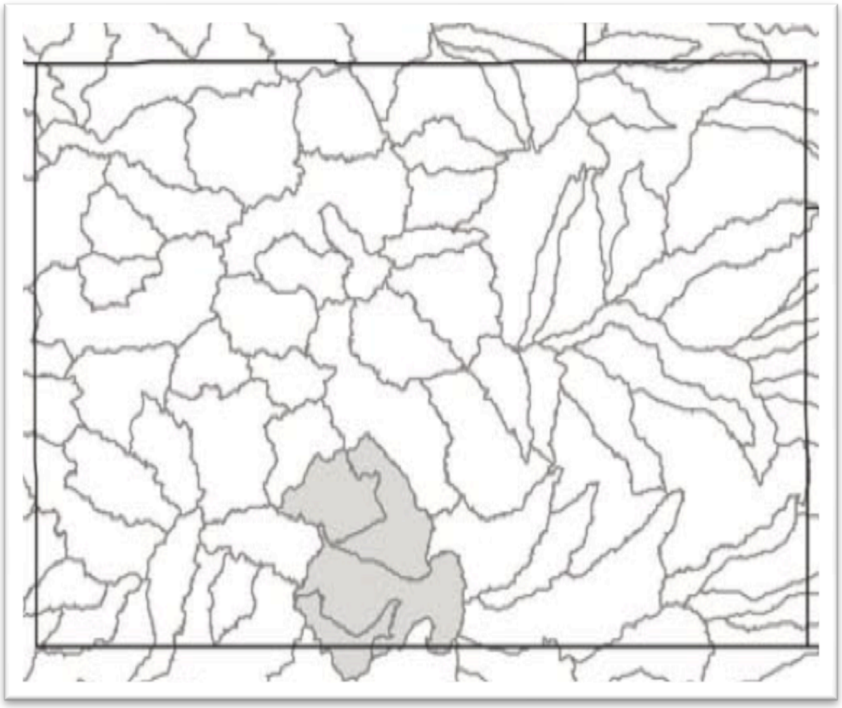
[1] Hydrologic Units are defined by watershed boundaries, and Figures 4 and 5 use the smallest divisions; 8-digit Hydrologic Code Units (John Caldwell, Native Fish Biologist, New Mexico Department of Fish and Game, personal communication, Aug. 11, 2014).

be a rare species in the Rio Grande Basin, Colorado" (Bestgen *et al*. 2003 at 32), and in surveys during 2001 to 2002 occurred in only one sample from Hot Creek. *Id*. at 23. One additional wild population was discovered in Crestone Creek (John Alves, Colorado Parks and Wildlife Senior Fisheries Biologist, personal communication, July 30, 2014; *see also* Lewis 2007, CPW 2006).

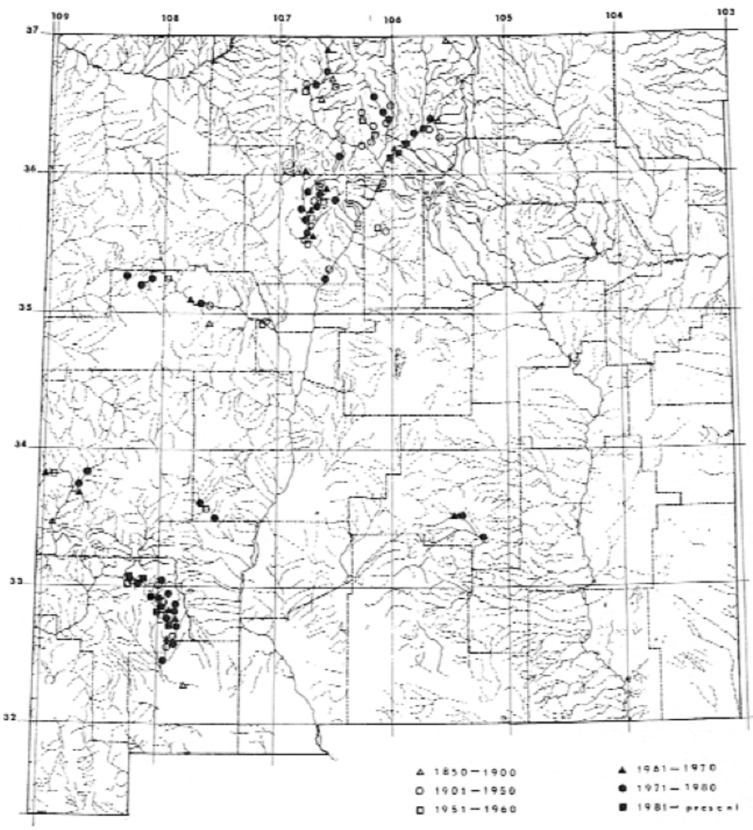
Figure 6. Hydrologic Unit Boundary units in Colorado containing Rio Grande sucker (Rees and Miller 2005 at 12, Figure 2).



New Mexico. "In New Mexico, Rio Grande sucker is believed to be largely extirpated from the mainstem of the Rio Grande, but still occurs in many tributaries of the Rio Grande; a disjunct population occurs in the Mimbres drainage" (Swift-Miller 2001 at 1). The majority of records are from the Middle Rio Grande and the Mimbres (Figures 4 and 7). "Of the 10 surviving native fishes of the Middle Rio Grande, five are rare or have relatively restricted distributions. Three of those five taxa (Rio Grande chub, *Gila pandora;* Rio Grande sucker, *Catostomus plebeius;* and Rio Grande cutthroat trout) were known to occur historically, but at unknown abundances, in the mainstream Rio Grande. They are now most abundant in upper elevations, in more cool to cold water tributaries" (Rinne and Platania 1995 at 170), and have "disappeared from several historic localities in northern New Mexico." *Id*. at 171. Introduced populations (probably introduced via bait bucket) were established in the Rio Hondo, Gila River Basin, and San Francisco drainages (Calamusso et al. 2002 at 182; Sublette et al. 1990 at 213-214; *see* Figure 4). The Rio Grande sucker may have been extirpated from five Hydrologic Units in New Mexico where it was once found (Figure 5); however some of those units may not have ever been Rio Grande sucker habitat (John Caldwell, Native Fish Biologist, New Mexico Department of Fish and Game, personal communication, Aug. 11, 2014; *compare* Figure 5 *to* Figure 7, *infra*).

Arizona. There are two introduced populations on the border of Arizona and New Mexico (Hammerson and Clausen 2013 at 2; Figure 4) but there is little information available on the extent of Rio Grande sucker range in Arizona and the status of the introduced populations. It is listed as a “State Exotic” in Arizona (BISON-M 2013 at 2); therefore this population will not be discussed further in this petition.

Figure 7. Historic distribution of the Rio Grande sucker in New Mexico (Sublette et al. 1990 at 214).



Mexico. The Rio Grande sucker is found in the endorheic Guzmán Basin (ríos Casas Grandes, Santa María, and del Carmen), south into the upper Río Conchos in Chihuahua and Durango, and in a single tributary of the Río Bavispe (Río Yaqui Basin) in Chihuahua (Miller 2005 at 148). Populations on the Pacific slope “in the ríos Fuerte, Mezquital, and Piaxtla… may constitute one or more distinct taxa and are not identified to species pending further study” (*Id.*; Figure 8).

In the Río Yaqui Basin, the species “is remarkably restricted in distribution… occurring only in the uppermost Río Gavilán drainage (Río Bavispe system) above 2,000 m… In the adjacent Piedras Verdes Basin (Ríos Casas Grandes system), [the Rio Grande sucker] ranges from high-elevation headwaters to well below 1,400 m. Perhaps the presence of two small, *Pantosteus*-like

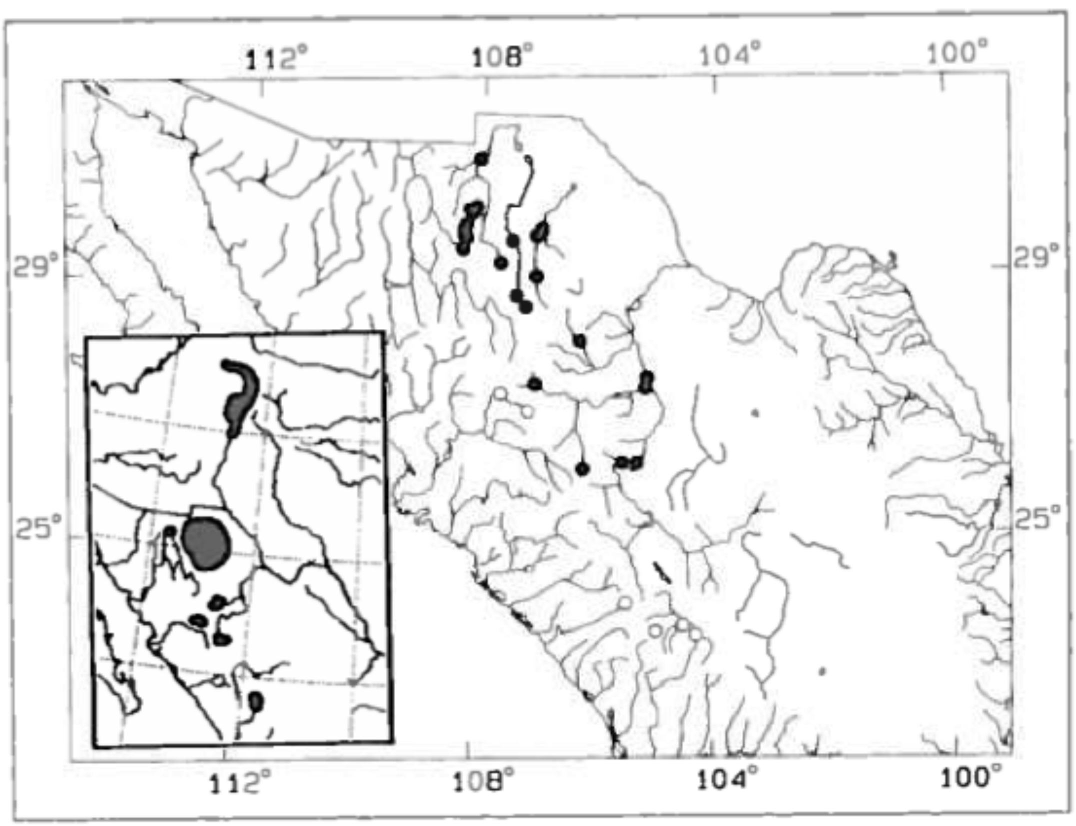
Catostomus[2] in the Río Yaqui headwaters, along with [*Catostomus*] *bernardini*, has impeded further invasion of the system by [Rio Grande suckers]" (Hendrickson et al. 1980 at 77-78).

The single population in the Río Bavispe (Figure 9) may be at risk from the growth of nearby cities:

> [C]onstruction of a highway between Huachinera and Bavispe will likely increase the chances of economic growth of these cities and those between them. A similar situation could be expected for those towns between Tres Ríos and Nuevo Casas Grandes where another road has been recently constructed. Unless economic growth is conceived and carried out in a well planned and sustainable fashion, severe and irreparable damage to the aquatic ecosystems may result. (Abarca et al 1995 at 377).

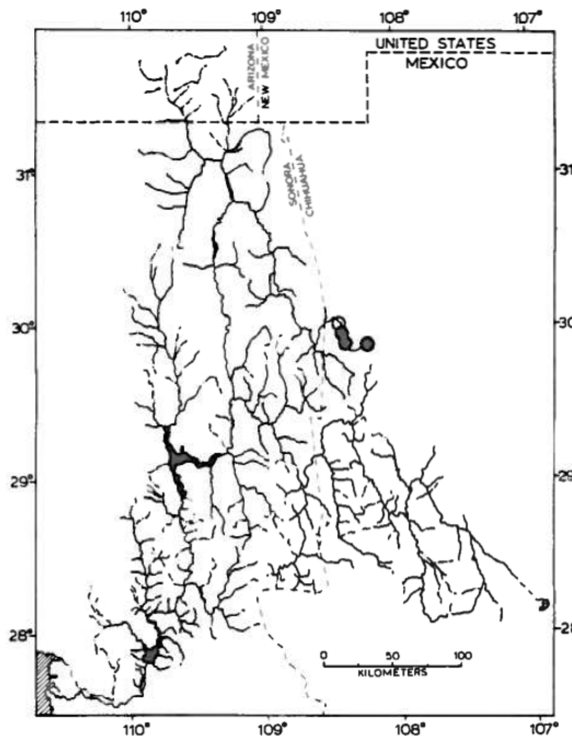
Contreras-Balderas et al. (2003 at 247) indicates that in addition to Chihuahua, the sucker is also present in Sonora, Tamaulipas and Coahuila, but not Durango. The reason for this apparent contradiction is unknown. Tamaulipas appears to be east of the species' reported range.

Figure 8. Distribution of the Rio Grande sucker in Mexico. Open circles indicate populations in the Fuerte, Mezquital, and Piaxtla rivers that may constitute one or more distinct taxa and are not yet identified to species (Miller 2005 at 148).



[2] This is in reference to two undescribed species of *Catostomus* documented in Hendrickson et al 1980 at 76-77.

Figure 9. Distribution of the Rio Grande sucker in the Río Yaqui Basin, Mexico (Hendrickson et al. 1980 at 78).



POPULATION STATUS: HISTORIC AND CURRENT

The Rio Grande sucker was historically abundant throughout its range from Colorado to Mexico. Jordan (1891 at 19-20) found the sucker "very abundant everywhere" in the Rio Grande Basin and lakes of Chihuahua. Ellis (1914 at 29) referred to it as "quite abundant throughout its range," which he characterized as "the Rio Grande drainage ranging from the San Luis Valley in Colorado south into Chihuahua." Cope and Yarrow (1875 at 675) found it "very abundant in the tributaries of the Rio Grande as far as [they] explored it," from Fort Garland, Colorado, to Santa Fe, New Mexico. They characterized it as the "prevalent [Catostomid] of that river basin… everywhere associated with *Salmo pleuriticus* and *Gila pandora*, &c." *Id*. These reports indicate that the Rio Grande sucker was historically abundant and widespread in the Rio Grande Basin, likely under conditions of low competition and optimal habitat. The Rio Grande sucker has suffered significant range contraction and population decline since the late 1800s (Langlois et al. 1994 at 8-10; Rees and Miller 2005 at 12; Calamusso et al. 2002 at 184).

Colorado. The Rio Grande sucker is now quite rare in Colorado, even after state listing as "endangered" in 1993. In surveys during 2001 to 2002 it occurred in only one sample from Hot Creek (Bestgen et al. 2003 at 23). The two known wild populations still extant in Colorado are located 1) west of La Jara, Conejos County, in Hot Creek, a tributary of La Jara Creek; and 2) in Crestone Creek on the Baca National Wildlife Refuge in Saguache County. The Crestone Creek population was discovered in 2005 (CPW 2006 at 1; Lewis 2007 at 2). In 2003, a U.S. Forest Service assessment described the species as "in even worse shape, at least in R2, than the Rio Grande cutthroat trout:"

> [The o]nly remaining historic population in R2 (Hot Creek, [Rio Grande National Forest]) is declining. Several transplants have been made, but there is little evidence of success so far. Competition, predation and hybridization with exotics are problems. The ubiquitous white sucker [is] especially problematic. The [Rio Grande] sucker has declined and [is] ultimately extirpated everywhere the white sucker establishes. This introduced species is now found in the Hot Springs drainage where the last historic [Rio Grande] sucker population occurs. In Colorado… remaining populations are disjunct, with little dispersal capability between populations because of habitat fragmentation and the establishment of exotics. Remaining habitat continues to be vulnerable to degradation from a variety of management activities, including: grazing, logging, road construction, water development, and others. It is very vulnerable to competition predation, fragmentation, and hybridization with exotics. (Patton 2003).

Since 1995, Rio Grande suckers have been reintroduced into seven aquatic systems; five of those populations are within the Rio Grande National Forest. Successful reproduction has only been confirmed in three streams (Rees and Miller 2005 at 12). Colorado Parks and Wildlife continues to conduct releases to maintain reintroduced populations, as they are difficult to establish. Releases to new areas are not currently planned, as it is difficult to find suitable undisturbed habitat; however, work to maintain current populations and establish new ones will continue (John Alves, Colorado Parks and Wildlife Senior Fisheries Biologist, personal communication, July 30, 2014; *see also* Lewis 2007, CPW 2006).

New Mexico. The New Mexico Department of Fish and Game is currently in the process of assembling Rio Grande sucker distribution information and conducting surveys to fill in knowledge gaps, and further information should be available in the fall of 2015 (John Caldwell, Native Fish Biologist, New Mexico Department of Fish and Game, personal communication, Aug. 11, 2014). Population status and trends for the Rio Grande sucker in New Mexico may be less clear than in Colorado, but it is apparent that both population and range have declined and the remaining populations face significant threats.

Surveys from 1992 to 1999 confirmed 16 populations in the Carson and Santa Fe National Forests, New Mexico. Population densities ranged from 100 fish per hectare to 5,400 fish per hectare (Calamusso et al. 2002 at 183). Two known populations appear to be extirpated in the Carson National Forest, leading the authors to consider the Rio Grande sucker "imperiled" in the northern portion of its range (Calamusso and Rinne 1999 at 233). The Rio Grande sucker appears to have a population stronghold in the Santa Fe National Forest where they are abundant in suitable habitat and are not co-existing with the non-native white sucker (*Id*.; *see also* Calamusso *et al*. 2002 at 183). Streams in the Jemez drainage of the Santa Fe National Forest do not contain white sucker, as the Jemez Canyon dam creates a barrier to migrating non-native fishes from the Rio Grande mainstem. *Id*. The study authors suggest that regulations be established to prevent the introduction of white suckers into the Jemez drainage via bait bucket (*Id.* at 236), and speculate that due to interactions with white sucker, Rio Grande sucker will continue to decline in the Carson National Forest, in tributaries of the Rio Chama, and in unprotected drainages emptying into the Rio Grande drainage. *Id*. In at least five streams with historic Rio Grande sucker populations or suitable habitat, white sucker appear to have replaced Rio Grande sucker (Calamusso et al. 2002 at 185).

In 1992, the Rio Grande sucker was reported from the upper Rio Grande and the Rio Grande near Santa Fe, Rio Chama, Jemez River, Rio San Jose, Elephant Butte Reservoir, Mimbres River, Rio Hondo, San Francisco River, and upper Gila River (BISON-M 2013, *citing* New Mexico Department of Game and Fish Fisheries Biologist Mike Hatch, 1992), however population numbers are not provided. In 1996, the species was reported as common in the Rio Grande and Mimbres River and moderately common in the Guzmán Basin (Hammerson and Clausen 2013 at 2, *citing* New Mexico Department of Game and Fish 1996 (*now transferred to* BISON-M)). However at around the same time, the sucker was reported to have "disappeared from several historic localities in northern New Mexico" (Rinne and Platania 1995 at 171). More recently, "Rio Grande sucker are considered rare in the Rio Grande mainstem and [are] declining in the tributaries of the Middle and Upper Rio Grande Basin" (Calamusso 2005 at 160, *internal citations omitted*). On the whole, the population is declining in New Mexico (NMDGF 2006 at 537; Swift-Miller 2001 at 1) and the species is considered "imperiled" in the state (NMDGF 2006 at 575).

Mexico. Population trends in Mexico are uncertain (Hammerson and Clausen 2013 at 1). The species is listed as "threatened" by Norma Oficial Mexicana. The species is considered threatened in Mexico because of habitat alteration, water depletion, exotic species, and most severely, population reduction (Contreras-Balderas et al. 2003 at 247).

IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The Rio Grande sucker meets at least three of the criteria for listing under ESA Section 4 (16 U.S.C. § 1533(a)(1)) (bolded):

A. **The present or threatened destruction, modification, or curtailment of habitat or range;**
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. **The inadequacy of existing regulatory mechanisms; and**
E. **Other natural or manmade factors affecting its continued existence.**

"More than 20 percent of the world's 10,000 freshwater species have become extinct, threatened or endangered in recent decades" (Wong 2007 at 5, *internal citations omitted*). Ricciardi and Rasmussen (1999 at 1221) predicted a future extinction rate of ~4 percent per decade for freshwater fishes, mollusks, crayfish, and amphibians, and a 2.4 percent future extinction rate for freshwater fishes. Almost 40 percent of North American fishes are currently imperiled; of those that were considered imperiled in 1989, most (89 percent) are currently in the same or worse conservation condition (Jelks et al. 2008 at 372). The loss of biodiversity in freshwater ecosystems is attributed to anthropogenic disturbances including changes in land use, climate change, nitrogen deposition (Sala et al. 2000 at 1772) introduction of nonnative species, habitat degradation, and introduction of diseases and parasites (Jelks et al. 2008 at 382).

Factor (A): The Present and Threatened Destruction, Modification, or Curtailment of Habitat or Range

"Habitat alteration is the single biggest cause of loss of diversity of aquatic life because few aquatic habitats have not been affected either directly or indirectly by human activities" (Moyle and Leidy 1992 at 145; *see Id*. at 145-152 *for a general discussion of causes and impacts of habitat loss in aquatic environments*). Indeed, habitat loss is one of the main drivers of Rio Grande sucker range contraction and population decline (Rees and Miller 2005 at 12; Jelks *et al*. at 393). Habitat loss has resulted from several factors related to anthropogenic changes in the Rio Grande Basin. Human use of water has influenced the sucker's habitat conditions, including water quantity, temperature, flow regime, sediment loads, and channel morphology. Alteration of these physical features combine to create stresses on Rio Grande sucker individuals and populations in a majority of the Rio Grande system. In Colorado, "[h]abitat condition trend varies from slightly improving to stable to downward. Stream dewatering, spring development, habitat degradation from grazing, roads, etc. still occurring in places. Lower elevation habitats on private land also impacted and declining in many places. Some improvements in habitat are occurring on public land as a result of improved management practices and restricted use as compared to historic use levels… Habitat is very vulnerable to modification from management activities including grazing, road construction, dewatering, logging, etc." (Swift-Miller 2001 at 2).

Habitat degradation is not a new threat. "A variety [of] habitat modifications in the Rio Grande basin from the late 1800s through the 1920s preceded the decline of the Rio Grande sucker" (Langlois et al. 1994 at 9). Early records of fish populations in Colorado noted the following:

> In the progress of settlement of the valleys of Colorado the streams have become more and more largely used for irrigation. Below the mouth of the cañons dam after dam and ditch after ditch turn off the water. In summer the beds of even large rivers (as the Rio Grande) are left wholly dry, all the water being turned into these ditches. Much of this water is consumed by the arid land and its vegetation; the rest seeps back, turbid arid yellow, into the bed of the stream, to be again intercepted as soon as enough has accumulated to be worth taking. (Jordan 1891 at 4)

"Unfortunately, pre-development conditions were never quantified… [D]evelopment proceeded rapidly throughout the late 19th century and withdrawals for irrigation largely depleted the Rio Grande by 1900" (Hoagstrom *et al*. 2010 at 79, *internal citations omitted*). Today, the Rio Grande is one of the most endangered rivers in North America (Rinne and Platania 1995 at 165).

> Both water-quantity and water-quality issues are major concerns… The Rio Grande failed to reach the Gulf of Mexico in much of 2002 and 2003. Water-quality problems include elevated salinity, nutrients, bacteria, metals pesticides, herbicides, and organic

> solvents. In addition, riparian areas in most parts of the basin are in decline, with nonnative species dominating in many reaches. (Dahm et al. 2005 at 192)

Dams and diversions. There are 68 dams and 13 reservoirs on the Rio Grande (Dudley et al. 2007 at 2074; *see* Figure 10 *for a partial accounting*). These dams and diversions reduce channel complexity and isolate fish populations (*Id*.). The Rio Grande Basin historically provided over 4,000 km of free-flowing habitat (*Id*.). Today there are only five remaining unfragmented portions over 100 km, leaving little free-flowing habitat to support native fish populations (*Id*.).

In the Middle Rio Grande, the location of some of the main historic and current Rio Grande sucker populations, the problem is particularly intense:

> Along the upper and middle reaches of the Rio Grande, six dams and three major diversions have been built. There are 321 [kilometers (km)] of canals (9.6 km concrete lined), 928 km of laterals (6 km lined), and 648 km of open and concrete pipe drains. The objective of these projects is to provide irrigation water, control sediment, and prevent flooding in the Middle Rio Grande Valley. Over 36,000 [hectares (ha)] of agricultural lands are irrigated by water diverted from this reach of the Rio Grande. On the lower Rio Grande in New Mexico and West Texas, there are two major dams, six diversion dams, 222 km of canals, 731 km miles of laterals, 744 km of drains, and one hydroelectric power generating facility. Most drains in this reach of river are unlined earthen structures. These structures provide irrigation water for 79,320 ha of farm land in addition to power generation for cities and industry in the region. Water is also provided to irrigate 10,117 ha in the Juarez Valley, Mexico. Today, the lower Rio Grande is essentially a conveyance ditch from the headwaters of Elephant Butte to the Texas border. (Calamusso 2005 at 152)

"Over 40 percent of the native species of the Middle Rio Grande have been eliminated from this reach of river" (Rinne and Platania 1995 at 168). "The principal threats to the remaining Middle Rio Grande fish fauna are water diversion and pumping for municipalities… water diversion has been (and continues to be) a factor in reducing both water quantity and quality in upper elevation tributary streams and rivers at the northern extent of the Middle Rio Grande." *Id*. Dams are also a threat to habitat in Mexico: "Detrimental land and water use practices and introduction of nonnative fishes throughout the Río Bavispe, above La Angostura Dam, are the most serious threats to the existence of its native fishes" (Abarca *et al*. 1995 at 376). Dams and water diversions affect fish populations, including Rio Grande sucker, through a variety of mechanisms: dewatering, habitat fragmentation, or changes in stream morphology and flow regime. These factors are discussed in more depth below (*for a general discussion of the impact of dams on southwestern grassland fishes, see* Calamusso 2005 at 152-154).

<u>Dewatering.</u> "Water to meet the instream needs of aquatic ecosystems is competing with other uses of water, and that competition is likely to be intensified by climate change" (Meyer *et al*. 1999 at 1378; *see* "Factor E: Climate Change" *infra*).

> Humans become successful competitors for water with fish and other organisms when they withdraw water from streams, lakes, springs or underground aquifers. [W]e are concerned primarily with impacts on fish communities resulting from the total or partial

desiccation of aquatic systems through various diversion, impoundment, and extraction practices. Water is withdrawn most often from aquatic environments for irrigation, flood control, and urban and industrial consumption. In arid western North America, such practices are a major direct cause of the decline of native fishes, and they are increasingly the cause of declines elsewhere, especially in semi-arid and arid regions of the world. (Moyle and Leidy 1992 at 142).

Figure 10. Dams and diversions along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico (Bullard and Wells 1992 at 1).

The Rio Grande is threatened by high levels of water extraction for agriculture and domestic use. In 2005, 366,000 acre-feet[3] (451,456,974 cubic meters) of water were diverted from the middle Rio Grande during the irrigation season (Wong et al. 2007 at 18). While irrigation accounts for more than 80 percent of all water taken from the river, municipal needs are growing as urban areas expand, *Id*. Along the Rio Grande mainstem, there are only four major cities, but the urban population is growing at a rapid rate of 2 to 4 percent per year. *Id.* "Habitat loss and fragmentation occur when streams are dewatered due to water use practices" (Rees and Miller

[3] One acre-foot is ~326,000 gallons, or enough to support an American family of five for a year (MTDNRC 2012 at 1).

2005 at 18). Studies have shown that reduced flows impact the Rio Grande chub, and they are likely to impact the co-occuring Rio Grande sucker in similar ways: reduced flows may impact the sucker directly by causing habitat fragmentation, or indirectly via reduced water quality, increased stress due to crowding, increased vulnerability to terrestrial predators, or higher water temperatures (Bestgen et al. 2003 at 33).

> The sporadic and cyclic desiccation and re-wetting of the mainstream Rio Grande channel severely impacts habitat availability, life cycles, and population levels of fishes throughout the Middle Rio Grande. During low-flow periods, fish are often trapped in pools where they may more readily fall prey to introduced game fishes. Even in absence of predation, fish trapped in intermittent pools may ultimately succumb due to declining water quality prior to re-connection of sustained flows. Fish appear to have a tendency to move upstream during periods of low-flow thereby concentrating populations below mainstream diversions. Below these areas, there is not only a greater probability of encountering predation, but also increased disease due to stress. Such concentration and crowding at the base of dams potentially increases the probability of the loss of a major portion of the native fish fauna during natural events such as de-oxygenation or human-caused activities such as spills of toxic materials. (Rinne and Platania 1995 at 169-170)

<u>Habitat fragmentation.</u> Rio Grande suckers are susceptible to habitat fragmentation from barriers such as dams and diversions.

> Large and small scale water development projects can have profound impacts on the persistence of Rio Grande suckers. Even undersized (or improperly designed) culverts at road or trail crossings can act as barriers, especially at low flows. Irrigation diversions and small capacity irrigation reservoirs reduce streamflow, alter the natural hydrograph, and provide barriers to migration and normal population exchange. Barriers that preclude fish passage can cause population fragmentation and completely prevent or significantly reduce genetic exchange between populations. The fragmented populations in some areas remain viable and maintain population levels at the same density as they were before fragmentation occurred. This currently occurs in tributaries to the Rio Grande that have become isolated from the mainstem river due to water diversions. In instances where habitat is fragmented and populations are isolated, the probability that genetic "bottlenecks" will occur becomes more pronounced, and single catastrophic events may extirpate populations from entire drainages. (Rees and Miller 2005 at 18).

Dams and diversions reduce channel complexity and isolate fish populations (Dudley et al. 2007 at 2074). The Rio Grande Basin historically provided over 4,000 km of free-flowing habitat. <u>*Id.*</u>. Today there are only five remaining unfragmented portions over 100 km, leaving little free-flowing habitat to support native fish populations. *Id*. Habitat loss and fragmentation significantly reduces genetic exchange between fish populations. Dams and diversions make isolated populations especially susceptible to extirpation by catastrophic events, because these populations cannot be recolonized from unaffected areas (Rees et al. 2005 at 16).

<u>Changes in stream morphology.</u>

> Land use practices that can impact stream channels include construction of roads through highly erodible soils, improper timber harvest practices, irrigation, and overgrazing in

> riparian areas. These can all lead to increased sediment load in the system and a subsequent change in stream channel geometry (e.g., widening, incision). These modifications alter width:depth ratios, pool:riffle ratios, and other aspects (e.g., pool depth) that affect the quality of habitat occupied by Rio Grande suckers. (Rees and Miller 2005 at 18)

<u>Changes in flow regimes.</u> The suite of native fish in the Rio Grande "would benefit from management to restore historical flow regimes and associated channel maintenance" (Rees et al. 2005 at 17).

> Flow regime changes may alter historic timing of spawning as well as use of seasonally available floodplain habitat. Severely reduced stream flows may lead to increased water temperatures, changes in the algal community, and reduced dissolved oxygen levels especially in smaller tributary systems. Although specific tolerances to water quality parameters (i.e., temperature, dissolved oxygen, toxicants) are undefined for this species, it is likely that as water quality is reduced, Rio Grande sucker fitness will also decline. (Rees and Miller 2005 at 18)

Sediment. Increased sediment loads negatively impact the abundance and condition of Rio Grande suckers (Reese and Miller 2005 at 13; Swift-Miller et al 1999a at 154). "Feeding habits of the Rio Grande sucker imply that it would prefer streams with low turbidity and minimal sediment deposition" (Reese and Miller 2005 at 15, *internal citations omitted*). They are rarely found in waters with heavy silt loads, and are negatively affected by erosion and sedimentation (Swift-Miller 1999b at 47), likely because silt deposition buries periphyton, their primary food source. "[S]ilt may impose an energetic cost by burying desirable foods increasing search and processing times. Other algae grazing fishes tend to avoid areas of high silt deposition" (Swift 1996 at 18). Turbid, silty areas also have less periphyton growth (Swift-Miller 1999b at 47). "Increased sediment deposition and resultant lost of food source is presumed to be one mechanism by which habitat degradation negatively influences Rio Grande sucker." <u>*Id*</u>.

> Water development, overgrazing, and other land use practices (i.e., channelization for agriculture, timber harvest practices, road management, mining) have resulted in increased sediment loads in many western streams… The presence of suspended sediment has been found to impact periphyton communities by increasing turbidity (resulting in a decrease in light penetration), and it can cause the removal of periphyton by a frictional scouring process. The deposition of fine sediments on periphyton communities is suspected to have a smothering effect and to decrease the nutritional value of periphyton by increasing the inorganic content. (Rees and Miller 2005 at 15, *internal citations omitted*)

In Jemez Creek, New Mexico, where land use practices have resulted in "massive erosion," inorganic fine sediment made up 91 percent of the material in Rio Grande sucker gut samples, suggesting that sediment deposition depletes and degrades their food supply. *Id.* at 16. "Much of the historic range of the Rio Grande sucker currently receives high sediment loads. The impact of sediments on some aquatic systems probably results in altered foraging behavior and depreciated nutritional benefits." *Id.* at 15-16. "Landscape scale changes and land use practices have resulted in an increase in the erodability of soils in the Rio Grande Basin. Modification of land use management techniques to decrease the impact to Rio Grande sucker habitat may lessen the anthropogenic threats to this species; however, it is unlikely that all impacts or threats could be minimized or halted." *Id*. at 19.

(C) Disease or Predation

The impact of disease and predation on Rio Grande suckers is uncertain, but there is some evidence this factor may be a threat. The Service should consider the potential impacts of disease and predation during the status review of the species.

Predation from introduced species. "The lack of protecting spines makes the Rio Grande sucker a desirable prey item for predatory native and non-native species. Non-native predators include northern pike and brown trout" (Rees and Miller 2005 at 18). Surveys in the 1980s revealed that waters inhabited by introduced northern pike (*Esox lucius*) did not contain Rio Grande suckers, which suggests a severe predation effect (Langlois et al. 1994 at 9). Swift-Miller et al. (1999b at 47) raised concerns regarding introduced brown trout (*Salmo trutta*) predation on Rio Grande suckers in Hot Creek, Colorado. Black bullheads (*Ameirus melas*) and yellow bulheads (*Ameirus natalis*) present a threat to native ichthyofauna in the Tres Ríos area of the Río Bavispe in Mexico, close to the only recorded population of Rio Grande sucker in the Río Bavispe; they were first recorded there in 1994 (Abaraca et al. 1995 at 374) and may have spread since then.

Disease. A high incidence of "black spot disease" (a metacercaria of various trematodes) in Rio Grande suckers may be related to the presence of white suckers (Rees and Miller 2005 at 16).

Factor (D): The Inadequacy of Existing Regulatory Mechanisms

The American Fisheries Society's Endangered Species Committee considers the Rio Grande sucker "vulnerable," meaning it is "a taxon that is in imminent danger of becoming threatened throughout all or a significant portion of its range" (Jelks et. al 2008 at 393). The species is ranked "vulnerable" range-wide by NatureServe (Hammerson and Clausen 2013 at 1), "critically imperiled" in Colorado and "imperiled" in New Mexico. *Id*. at 4. These designations do not provide any regulatory protection, but support our conclusion that the Rio Grande sucker is imperiled.

Federal.

U.S. Forest Service. The Rio Grande sucker is present in U.S. Forest Service (USFS) Regions 2 and 3: on the Cibola, Carson, Gila, and Santa Fe National Forests in New Mexico (USFS 2013 at 2) and the Rio Grande National Forest in Colorado (Swift-Miller 2001 at 4). Region 3 lists the Rio Grande sucker as "sensitive" (USFS 2013 at 2). USFS objectives with regard to sensitive species are as follows:

1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

2. Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.
3. Develop and implement management objectives for populations and/or habitat of sensitive species.

Forest Service Manual § 2670.22 (2005)

The "viable population" standard is a lower bar than "conservation" under the ESA. The definition of conservation under the ESA includes recovery: "[the] terms 'conserve,' 'conserving,' and 'conservation' mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary." 16 U.S.C. § 1532(3). The ESA establishes a chain of connected responsibilities on the Service to ensure the conservation and recovery of listed species. These responsibilities amount to a duty and mandate to conserve and recover all listed species. *See Sierra Club v. Clark,* 755 F.2d 608, 612 (8th Cir. 1985) (under ESA § 4(d) the Service must ensure its actions always provide sufficient protection to guarantee continued progress toward recovery of listed species) *and Gifford Pinchot Task Force v. U.S. Fish & Wildlife*, 378 F.3d 1059, 1077 (9th Cir. 2004) ("the ESA was enacted not merely to forestall the extinction of species (i.e., promote a species' survival), but to allow a species to recover to the point where it may be delisted").

In contrast, a "viable population" is defined as a "population that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range in the planning area. For forest planning purposes, a planning area is one or more identified National forest(s)." Forest Service Manual § 2605 (2005). The "continued existence" of a species is not equivalent to conservation and recovery under the ESA.

USFS policy with regards to sensitive species is as follows:

1. Assist states in achieving their goals for conservation of endemic species.
2. Review programs and activities as part of the National Environmental Policy Act of 1969 process through a biological evaluation, to determine their potential effect on sensitive species.
3. Avoid or minimize impacts to species whose viability has been identified as a concern.
4. Analyze, if impacts cannot be avoided, the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. (The line officer, with project approval authority, makes the decision to allow or disallow impact, but the decision must not result in loss of species viability or create significant trends toward federal listing.)
5. Establish management objectives in cooperation with the states when projects on National Forest System lands may have a significant effect on sensitive species population numbers or distributions. Forest Service Manual § 2670.32 (2005)

These policies require the Forest Service only to "assist states," review programs and activities," and "establish objectives." The policy does not require the Forest Service to avoid impacts to sensitive species, but rather to "avoid *or minimize*" impacts (emphasis added) and "if impacts cannot be avoided," to "analyze" their significance. Nowhere here is the affirmative duty to conserve mandated by the ESA.

According to the Forest Service Manual, the Forest Supervisors:

> 1. Ensure that legal and biological requirements for the conservation of endangered, threatened, and proposed plants and animals are met in forest land and resource management planning; ensure compliance with procedural and biological requirements for sensitive species.
> 2. Develop quantifiable recovery objectives and develop strategies to effect recovery of threatened and endangered species. Develop quantifiable objectives for managing populations and/or habitat for sensitive species…
> 4. Determine distribution, status, and trend of threatened, endangered, proposed, and sensitive species and their habitats on forest lands.

Forest Service Manual § 2670.45 (2005).

Before species are listed or proposed, Forest Supervisors only have to "ensure compliance with procedural and biological requirements" for sensitive species, which does not contain a duty to conserve and recover but only to ensure "viability," which as explained above is a lower bar. Forest Supervisors must develop objectives for managing populations and habitats for sensitive species, but nowhere are those objectives required to be implemented on the ground.

Forest Plan Objectives, according to the manual, are "[f]or sensitive species, [to] include objectives in Forest plans to ensure viable populations throughout their geographic ranges. Once the objectives are accomplished and viability is no longer a concern, species shall not have 'sensitive' status." Forest Service Manual § 2672.32 (2005). Nowhere is the USFS required to *accomplish* the "included" objectives. The manual only notes that once and if the objectives are accomplished, the species will no longer be considered sensitive. There is no requirement that the USFS work toward accomplishing objectives and removing species from the sensitive species list in a timely manner, or at all.

In general, USFS regulations regarding sensitive species appear to be focused on avoiding listing under the ESA and the associated mandatory duties under federal law, rather than prioritizing species conservation and recovery, as the ESA does. That the first policy objective in regards to sensitive species is to "[d]evelop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions" is particularly telling.

<u>Bureau of Land Management</u>. The New Mexico state office of the Bureau of Land Management (BLM) lists the Rio Grande sucker as "sensitive" (BISON-M 2013 at 1).

> [T]he BLM shall designate Bureau sensitive species and implement measures to conserve these species and their habitats, including ESA proposed critical habitat, to promote their conservation and *reduce the likelihood and need for such species to be listed pursuant to the ESA.*

BLM Manual § 6840.2 (2008), *emphasis added*,

Again, these regulations appear less concerned with survival and recovery of species than with avoiding federal listing. "Designating measures" to "promote" conservation is not equivalent to protecting a species.

> When BLM engages in the planning process, it shall address Bureau sensitive species and their habitats in land use plans and associated NEPA documents... When appropriate, land use plans shall be sufficiently detailed to identify and resolve significant land use conflicts with Bureau sensitive species without deferring conflict resolution to implementation-level planning. Implementation-level planning should consider all site-specific methods and procedures needed to bring species and their habitats to the condition under which management under the Bureau sensitive species policies would no longer be necessary.

BLM Manual § 6840.2B (2008).

To "address" sensitive species in land use plans is not the same as to protect them. The rest of this regulation is discretionary and carries no affirmative duty to conserve and recover sensitive species:

> On BLM-administered lands, the BLM shall manage Bureau sensitive species and their habitats to minimize or eliminate threats affecting the status of the species or to improve the condition of the species habitat, by:
>
> 1. Determining, to the extent practicable, the distribution, abundance, population condition, current threats, and habitat needs for sensitive species, and evaluating the significance of BLM-administered lands and actions undertaken by the BLM in conserving those species.
> 2. Ensuring that BLM activities affecting Bureau sensitive species are carried out in a way that is consistent with its objectives for managing those species and their habitats at the appropriate spatial scale.
> 3. Monitoring populations and habitats of Bureau sensitive species to determine whether species management objectives are being met.
> 4. Working with partners and stakeholders to develop species-specific or ecosystem-based conservation strategies…
> 5. Prioritizing Bureau sensitive species and their habitats for conservation action based on considerations such as human and financial resource availability, immediacy of threats, and relationship to other BLM priority programs and activities.
> 6. Using Land and Water Conservation Funds, as well as other land tenure adjustment tools, to acquire habitats for Bureau sensitive species, as appropriate.
> 7. Considering ecosystem management and the conservation of native biodiversity to reduce the likelihood that any native species will require Bureau sensitive species status.
> 8. In the absence of conservation strategies, incorporate best management practices, standard operating procedures, conservation measures, and design criteria to mitigate

> specific threats to Bureau sensitive species during the planning of activities and projects.

BLM Manual § 6840.2C (2008).

These regulations are much weaker and less enforceable than protections under the ESA. Firstly, the BLM is not required to eliminate threats, only to eliminate *or minimize* them. The BLM must ensure that its activities are consistent with "objectives for managing [sensitive species] and their habitats," but does not here define those management objectives or require them to be science-based or measurable. The rest of these regulations are discretionary or require only "consideration" or "prioritization" of species rather than enforceable protections as would be required by an ESA listing.

Neither USFS nor BLM sensitive species designation is an adequate regulatory mechanism to protect species on the brink of extinction.

Water use regulations. State and federal water policy is not adequate to protect flows in the Rio Grande necessary for the conservation and protection of the Rio Grande sucker and other river-dependent species. Western water law—the system of prior appropriation—values the diversion of water from rivers and streams for "beneficial use" at the expense of river flows and the natural environment (Johnson and DuMars at 350). Such state policies allocate water for agriculture, municipal and industrial purposes on a "first come, first served" basis. Thus, the oldest water rights have first priority over any subsequently developed water right. Historically, instream flow rights were not recognized because the requisite intent of a "diversion" did not exist. *Id*. While certain states now recognize instream flow rights, most rights were developed relatively recently and thus are junior to existing consumptive uses such as agriculture. Therefore, the system of modern prior appropriation does not provide an adequate tool for securing river flows to protect river-dependent species.

In Colorado, "water rights are based on the appropriation system which requires the permanent fixing of rights to the use of water at the time of the adjudication, with no provision for the future needs" (C.R.S. § 37-92-101 (2014)). The Colorado Constitution, Article XVI, Section 6 provides that "[t]he right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied." Thus, Colorado prioritizes diversion of water from our rivers for traditional domestic, agricultural and industrial uses over more modern values such as instream flows. For example, since the 1890s "the irrigated lands in San Luis Valley used all the available natural flow of [the] Rio Grande and its tributaries in that valley" (NRC 1938 at 8). Dewatering of the river threatens many species including the Rio Grande sucker (*see* "Factor A," *supra*). Such agricultural diversions from the San Luis Valley of Colorado continue today, consuming nearly all of the headwater's flows and leaving only a trickle at the Colorado-New Mexico state line. For example, in 2013, 99 percent of the Rio Grande's flows were consumed between the Del Norte gauge located above the diversions in the San Luis Valley and the Lobatos Gauge near the Colorado-New Mexico state line.

In 1973, Colorado's legislature "recogniz[ed] the need to correlate the activities of mankind with some reasonable preservation of the natural environment" and granted the Colorado Water

Conservation Board (CWCB) the authority to file for and hold instream flow water rights in Colorado (C.R.S. § 37-92-102(3)). As of 2012, the CWCB had acquired instream flow rights on 9,120 stream miles in Colorado: 8 percent of the state's total miles and 30 percent of its perennial miles (CWCB 2012; EPA 1998 at Appendix A). However the instream flow rights held by CWCB remain junior to prior water rights and represent a tiny fraction of the water rights in the state: 0.31 percent of the water consumed for agriculture in 2005 (Gardner-Smith 2014 at 3). "As a result, streams where the CWCB holds junior rights are often still left shallow or dry after senior water rights for irrigation are exercised." *Id*.

In New Mexico, all water is subject to appropriation for human use: "[t]he unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use, in accordance with the laws of the state" (New Mexico Constitution, Article XVI, Section 2). "[A]ll waters appropriated for irrigation purposes… shall be appurtenant to specified lands owned by the person, firm or corporation having the right to use the water, so long as the water can be beneficially used thereon... Priority in time shall give the better right" (N.M.S. § 72-1-2 (2013)).

Similar to Colorado, New Mexico places a high value on consumptive water uses. As a result, water is diverted from the Rio Grande at a rate that is not sustainable. Dewatering of the river threatens many species, including the Rio Grande sucker (*see* "Factor A," *supra*). Both municipal and agricultural water uses must be reformed and water must be re-allocated to the Rio Grande itself if the river and its inhabitants are to survive and thrive, especially in light of the growing threat of climate change in the Southwest (*see* "Factor E," *infra*). WildEarth Guardians is intimately familiar with this issue as we are currently in litigation to secure the Rio Grande rights to its own water (*for background, see* Paskus 2014).

State. Though the sucker is protected in Colorado, the majority of its U.S. range is in New Mexico where it is afforded no state protections.

<u>Colorado.</u> Colorado included the Rio Grande sucker on the state list of endangered wildlife in 1993. Any Rio Grande sucker "taken by any means shall be returned unharmed to the water immediately" (Langlois et al. 1994 at 4). Colorado Division of Wildlife (now Colorado Parks and Wildlife (CPW)) published a recovery plan for the species in 1994 (*Id*., *entire*). The recovery objective was to create at least three stable metapopulations, one in each river basin of the San Luis Valley: the Closed Basin, Rio Grande and Conejos drainages (*Id*. at ii). Lack of available habitat may preclude meeting this recovery goal (John Alves, personal communication, July 30, 2014). Recovery actions to date include development of two brood stock populations—one for the Closed Basin and one for the Rio Grande Basin—in the state Native Aquatic Species Facility, establishment and maintenance of new populations, and stream surveys that located a second wild population in Crestone Creek (*Id*.).

Recovery efforts in Colorado are important for maintaining populations of the sucker in the northernmost part of its range. However, Colorado contains only a small portion of Rio Grande sucker range. Releases to new areas are not currently planned as it is difficult to find suitable undisturbed habitat (John Alves, Colorado Parks and Wildlife Senior Fisheries Biologist, personal communication, July 30, 2014). Though the sucker may have greater state regulatory protections in Colorado than elsewhere, it is still threatened throughout a significant portion of its range where it lacks such protections. In addition, protection of the few populations in Colorado do not ensure the survival of the species as a whole, as many of the Colorado populations are tenuously established and/or isolated and vulnerable to stochastic events.

<u>New Mexico.</u> New Mexico lists the Rio Grande sucker as a "species of greatest conservation need" (SGCN) (BISON-M 2013 at 1). SGCN are given priority in the New Mexico Department of Game and Fish's (NMDGF) Comprehensive Wildlife Conservation Strategy; however the only action mentioned in the plan that specifically addresses the sucker is the acknowledgment that "[r]research and survey work is needed to obtain comprehensive population data for Rio Grande sucker and Rio Grande chub… in the [Rio Grande] watershed" (NMDGF 2006 at 353, 356). The NMDGF intends to "[i]nclude non-game species in NMDGF fish survey analysis to improve baseline information regarding distribution and status of SGCN within the watershed" (*Id*. at 354, 357). Information collection is ongoing (*see* "Population Status: Historic and Current," *supra*) but though important this is not sufficient to protect the sucker from the threats the species faces.

Natural Heritage New Mexico lists the sucker as "S2," "imperiled in NM because of rarity or because of some factor(s) making it very vulnerable to extirpation from New Mexico. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000)" (NMNH 2002; NHNM 2014 at 2). This designation provides no regulatory protection, but supports our argument that the species is imperiled.

Mexico. The Rio Grande sucker is listed as "threatened" by Norma Oficial Mexicana (NOM), meaning that it "may be in danger of extinction in the short- or medium-term, if the factors adversely affecting its viability continue to operate by causing habitat deterioration or modification or directly reducing the size of its population. This category overlaps with IUCN's 'vulnerable' category" (NOM-059-ECOL-2001 3.2.3, *translated from original Spanish*). Legal protections in Mexico may not be effective however; of the NOM list, Contreras-Balderas *et al*. (2003 at 242) remark that "the governmental and technical Committee in charge call for an evaluation of the risk [to listed species]. Since Mexico has not had a program for financing appropriate assessments of species at risk, this condition can hardly be fulfilled… As in other parts of the world, we suffer from a very limited supply of experts, time, funds, and interest in at risk species, hence, information about species has to be derived from other programs." Almost 40 percent of the known freshwater fish species in Mexico are at risk or extinct (Contreras-Balderas et al. 2003 at 242). Threats to freshwater environments in Mexico are many and varied, including human population growth, pollution from urban areas, dewatering due to groundwater extraction, dams and impoundments, and non-native species (Miller 2005 at 60-61). "[A]n appalling number of endemic species and affected aquatic habitats will almost certainly disappear before an adequate and rational system of species conservation and protected areas can be attained" (Miller 2005 at 62, *quoting* Contreras-Balderas 1991).

The Yaqui Fishes Recovery Plan (USFWS 1994) may provide some protection to sucker habitat in the southern U.S. and Mexico, but only to the isolated population of suckers in the Río Yaqui Basin. The Plan does not specifically mention the sucker.

Factor (E): Other Natural or Manmade Factors Affecting Continued Existence

Competition with nonnative species. Nonnative fish are causing declines in native fish populations throughout the Rio Grande Basin. Faunal changes in the Albuquerque and Belen valleys of the Rio Grande showed declines in sensitive natives and increases in non-natives (Hoagstrom et al. 2010 at 83). "To maintain the stability of the Rio Grande sucker population and perhaps the entire native fish community it is important to prevent the reintroduction of non-native fishes" (Langlois et al. 1994 at 16). The Rio Grande sucker appears sensitive to competition from nonnative fish species; in particular, its population viability is being degraded and its habitat lost due to competition with the white sucker (*Catostomus commersonii*). White suckers have been found in the upper Rio Grande basin since 1945 (Rees and Miller 2005 at 12 *citing* Zuckerman and Langlois 1990). "In the streams of the Rio Grande drainage, both species occupy similar habitats and consume the same food items and, thus, are likely to compete for these resources when and where they are rare" (McPhee 2007 at 15).

In northern New Mexico, all streams where the Rio Grande sucker is declining or extirpated have been colonized by the white sucker (Calamusso et al. 2002 at 184). Conversely, the Rio Grande sucker is most abundant in streams that have not been invaded by the white sucker (McPhee 2007 at 15). Rio Grande sucker abundance and condition are negatively correlated with white sucker abundance. *Id*. Displacement of Rio Grande suckers in the presence of white sucker populations is thought to result from several mechanisms, including hybridization, direct competition for limited resources (e.g., food, spawning habitat, rearing areas) (Rees and Miller 2005 at 12, 18), and the spread of disease. *Id.* at 16. The white sucker is a generalist and well-adapted to a range of degraded environmental conditions, giving it a competitive advantage (*Id.* at 18) since "[t]he Rio Grande sucker probably evolved with adequate food resources and limited interspecific competition." *Id.* at 15. In particular, the large body size and high fecundity of the white sucker likely contribute to its dominance (McPhee 2007 at 23). Even under natural conditions, the Rio Grande sucker does not appear competitive with other sucker species. In the Río Bavispe, México, "competition from ecologically similar but unrelated suckers[4] evidently has greatly curtailed [Rio Grande sucker] dispersal" (Miller 2005 at 148; *see* "Geographic Distribution: Historic and Current, *supra*). So "perhaps it is no surprise that Rio Grande sucker is not faring well with the relatively recent introduction of white sucker—an examination of the evolutionary history of the Rio Grande sucker indicates that it did not evolve with another sucker species, and thus is not evolutionarily programmed for adapting to this kind of competition" (Swift 1996 at 98).

In regards to native fishes generally, Hoagstrom et al. (2010 at 85-86) write: "It is uncertain whether changing [population] dominance portends future extirpations or simply reflects short-term fluctuations in populations. If it indicates long-term trends, the relict populations of sensitive, native fishes appear to be threatened with extirpation." The downward trends in, and extirpations of, Rio Grande sucker populations in the presence of the white sucker are concerning since the native species is likely threatened with extirpation or continued significant decline if nothing changes.

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[4] Presumably the two undescribed species of *Catostomus* documented in Hendrickson et al. 1980 at 76-77, and *C. bernardini.*

Hybridization. Introgression of white sucker genes into the Rio Grande sucker population has been inferred from specimens exhibiting intermediate morphology (McPhee and Turner 2004 at 86). For example hybridization between the Rio Grande sucker and the white sucker was reported in Hot Creek (Rees and Miller 2005 at 14 *citing* Zuckerman and Langlois 1990; Swift-Miller et al. 1999b at 46), and in the McIntyre Springs population several years prior to the extirpation of Rio Grande suckers at that location (Rees and Miller 2005 at 14 *citing* Zuckerman and Langlois 1990). But genetic evidence indicates that hybridization occurs rarely, if at all. The loss of genetic integrity through hybridization is likely not a conservation concern (McPhee and Turner 2004 at 92). "However, hybridization cannot be disregarded as a factor in the decline of *C. plebeius*. If interspecific matings do occur, it is possible that a substantial portion of the adult population is wasting energy on the production of inviable F1 hybrids. This could contribute to the continued decline of *C. plebeius* when in the presence of *C. commersoni.*" *Id*. The white sucker and Rio Grande sucker are so phylogenetically distant that hybrids are likely infertile (Swift-Miller et al. 1999b at 47).

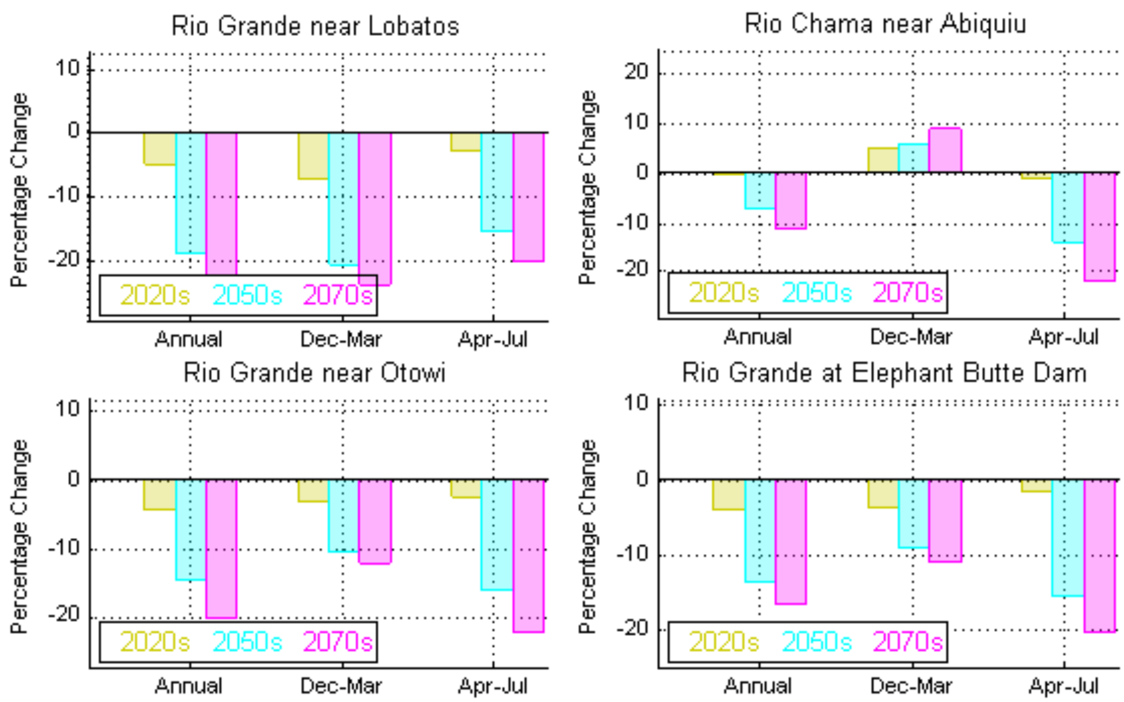
Genetics. "Existing populations are disjunct, occurring in isolated stream segments. Dispersal capability [is] likely very low due to fragmented habitat or non-native species serving as barriers to movement" (Swift-Miller 2001 at 1). "The current intermittent nature of most tributary streams with reintroduced or natural populations of Rio Grande suckers effectively eliminates gene flow between these populations. The potential loss of genetic heterogeneity and diversity is unknown at this time. It is a logical conclusion that the isolated populations are more vulnerable to impacts from catastrophic events" (Rees and Miller 2005 at 14).

Climate change. Climate change has and will continue to affect hydrology and ecosystems across the American West. Up to 60 percent of the climate-related trends in river flow, winter air temperature and snow pack between 1950-1999 were influenced by human-induced climate change (Barnett et al. 2008 at 1080).

The Rio Grande Basin faces particular threats from climate change. A report prepared for Congress by the U.S. Bureau of Reclamation (BOR) found that warming without precipitation change over the Rio Grande Basin will likely "lead to increased watershed evapotranspiration, decreased spring snowpack and snowmelt, and ultimately reduced water supplies" (BOR 2011 at 121). The average temperature of the Rio Grande Basin has increased by approximately 1 to 2°F over the course of the 20th century. *Id.* at 108. The basin's average temperature increased from the 1910s to the mid-1940s, before declining slightly until the 1970s. Since then, the temperature has increased steadily. *Id*. The basin-average mean-annual temperature in the Upper Rio Grande Basin is expected to increase by roughly 5 to 6°F during the 21st century. *Id.* at 111. Additionally, BOR projections indicate that overall precipitation will gradually decline over much of the basin during the course of the 21st century. *Id.* at 111. And although the overall magnitude of precipitation is projected to decrease, the character of precipitation within the Upper Rio Grande basin is expected to change as temperatures increase over time, resulting in more frequent rainfall events and less frequent snowfall events. *Id.* at 115. Temperature and precipitation changes are expected to affect hydrology in various ways; warming is expected to diminish the accumulation of snow during the cool season and the availability of snowmelt to sustain runoff to the Upper Rio Grande during the warm season. *Id*.

Projected climate changes are likely to have an array of interrelated and cascading ecosystem impacts. *Id.* at 123. Changes in climate and snowpack within the Upper Rio Grande Basin will alter the availability of natural water supplies, runoff levels, and flood peaks. Throughout the Rio Grande Basin, decade-mean annual runoff is projected to steadily decline through the 21st century as a result of decreasing precipitation and warming. *Id.* at 115. Total annual runoff could decline as much as 25 percent in some parts of the river (Figure 11). Decreasing minimum runoff and the resulting reduced water flow adversely affects habitats through reduced availability of aquatic habitat and increased water temperatures. *Id.* at 117. The resulting low flows will likely compound the already-pervasive impacts of dewatering on Rio Grande sucker habitat.

Figure 11. Simulated changes in decade-mean runoff for four subbasins in the Rio Grande basin. Each panel shows percentage changes in mean runoff (annual and seasonal) for three future decades (2020s, 2050s, and 2070s) relative to 1990s baseline conditions (BOR 2011 at 118).



A study conducted primarily in the northern Rio Grande Basin in Colorado and New Mexico detected several trends over a 45-year period which support these projections. The study found significantly increasing trends in mean annual air temperature (Zeigler et al. 2012 at 1049), a decrease of 5.3 percent per decade in Snow Water Equivalent (SWE) trends, and a shift in timing of spring snowmelt to 10.7 days earlier. *Id.* at 1050. Reduced snowpack, earlier runoff, and higher evaporative demands will affect vegetative cover and species' habitat (Hurd and Coonrod 2007 at 24). "Increased summer air temperatures could increase dry season aquatic temperatures and affect fisheries habitat" (BOR 2011 at 123).

> A change in water temperatures is the most likely effect of climate change in most regions, and this change will have secondary effects on water quality parameters (e.g.,

> dissolved oxygen) and biotic processes… Changes in thermal regime pose threats to a broad range of higher level population and community interactions, ranging from direct mortality from acute temperature stress, chronic bioenergetic stresses, and shifts in the balance of interspecies competition as habitat space for some species is reduced. (Meyer et al 1999 at 1378)

Changing water temperatures and flow regimes may impact Rio Grande sucker spawning. Rio Grande suckers have been reported spawning at temperature ranges between 9 and 16°C (48.2 to 60.8°F) (*see* "Life History," *supra*), and temperature is likely a controlling factor for Rio Grande sucker spawning (Calamusso 2005 at 160). One study indicated that spawning peaked in June during the declining spring flows. *Id*. "Much information is still needed regarding spawning activities [and] reproductive success" (Rees and Miller 205 at 14), but studies of other fish whose spawning is sensitive to temperature and flow regime indicates that climate change is likely to impact spawning in a variety of ways.

> It appears that species that cue on discharge are most likely to suffer negative consequences of climate change because it is predicted to decouple the autocorrelation of high and low flows, thus diminishing the information content of this cue… Biological responses to altered timing, magnitude, and duration of surface water flows are likely to be both ecological and genetic in nature, which suggests the need for integrated research efforts to characterize and predict these responses. (Turner et al. 2010 at 442-443, *internal citations omitted*)

Climate warming may also increase competition and hasten the spread of invasive species. "[C]ompetition with surrounding communities (or invasive aliens) appears to accelerate the breakdown of 'islands' of relict vegetation which might otherwise be more resistant to direct climate effects" (Hampe and Petit 2005 at 465-466). "The timing, duration, and severity of a specific temperature anomaly may cause undesirable biological organisms (i.e. invasive) to thrive, and strain physical resources such as water and its sources (e.g. snow and glaciers)" (Pedersen et al. 2010 at 136).

Climate change could also result in changed demand for instream flow or reservoir releases to satisfy human needs, such as hydropower generation, municipal and industrial water deliveries, river and reservoir navigation, and agricultural and recreational uses (BOR 2011 at 125).

> [C]ompetition over limited water resources remains a serious stress to aquatic ecosystems… humans currently appropriate [an estimated] 54 percent of runoff that is geographically and temporally accessible to them. This competition is likely to be intensified by climate change. Hence climate-induced changes must be assessed in the context of existing demands for a limited supply of water and massive human-induced changes in water quantity and quality that have resulted from altered patterns of land use, water withdrawal, and species invasions. (Meyer et al. 1999 at 1374)

Species and habitats already stressed by water diversion will be less able to cope with climate change (Loarie et al. 2009 at 1054). Research suggests that species and ecosystems will need to shift (northward, away from the equator) an average of 0.42 km per year to survive the deleterious effects of increasing temperatures associated with climate change. *Id.* at 1052. Models of habitat condition shifts under various climate change scenarios for fish species in the Rio Grande Basin indicate that five fish species, including the Rio Grande sucker, will see their appropriate conditions shift upwards in elevation and their suitable habitat reduced (Cohen et al. 2013 at 19). Whether or not the Rio Grande sucker will be able to move along with projected climactic shifts is uncertain, as the model represents climatic habitat condition only and does not take into account other biotic conditions that may influence distribution, such as interspecific competition, dispersal, habitat connectivity, behavioral adaptations, ecological equilibria, or evolution. The model also does not incorporate man-made barriers to dispersal or migration such as dams or diversions. *Id*. We believe it unlikely that small, isolated populations of the imperiled sucker, already dependent on diminished habitats, will be able to shift to other habitats to adapt to the effects of climate change.

Human population growth. "The ultimate cause of most loss of biodiversity is the exponential expansion of human populations. Until that expansion and the concomitant rapidly expanding use of natural resources cease, any efforts to protect species from extinction will be short-term 'holding actions'" (Moyle and Leidy 1992 at 141). As noted in Factor A, *supra*, municipal needs for water are growing as urban areas expand (Wong et al. 2007 at 18). Along the Rio Grande mainstem, the urban population is growing at a rapid rate of 2 to 4 percent per year. *Id*. The current pressure on the Rio Grande to provide water for municipal and agricultural use will increase with increasing population and will likely be exacerbated as climate change continues to impact the Rio Grande Basin. Currently, management of the Rio Grande does not sufficiently protect water for the river itself (*see* "Factor D," *supra*), and therefore as human demand increases, there is no guarantee that natural flows will be maintained.

Public opposition to protection. "[Rio Grande suckers] can be perceived by some people near their habitat areas as 'trash fish' that have little or no worth… The sucker is viewed by some as an obstacle to economic development. Local public sentiment may characterize this species as an impediment to water management and development in portions of the San Luis Valley" (Langlois et al. 1994 at 18; *see also* Lewis 2007 at 3, *characterizing the species as having an "image problem"*).

> Problems are inherent when trying to save native fish. First, because many native Southwestern fishes are nongame species considered by many, even in resource agencies, as "rough fish," garnering support from private land owners or individuals and companies leasing public lands can be a challenge. Second, funding conservation efforts for native fish is a challenge because of budgetary constraints, political climate of the time, and, again, the view of these fishes as somewhat less desirable than game fish. Third, the frequent lack of information and communication among scientists might even be encouraged by what is perceived as small "cliques" of researchers whose intention is development of their own view on how the species should be managed. Fourth, water is an ever-decreasing resource in the Southwest, and many water laws permit beneficial water use without regard to fish and wildlife. (Calamusso 2005 at 157)

Small, isolated populations. The Service has previously recognized that small population size and small, isolated populations increases the likelihood of extinction.[5] For example, in reference to the Sisi snail (*Ostodes strigatus*), the Service noted that "[e]ven if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the known populations." Heightened risk of extinction is "inherent in low numbers," a basic tenet and cornerstone of conservation biology (Caughley 1994 at 216). Small, isolated populations such as those of the Rio Grande sucker, particularly in Colorado, are vulnerable to: 1) demographic fluctuations, 2) environmental fluctuation in resource or habitat availability, predation, competitive interactions and catastrophes, 3) reduction in cooperative interactions and subsequent decline in fertility and survival, 4) inbreeding depression reducing reproductive fitness, and 5) loss of genetic diversity reducing the ability to evolve and cope with environmental change (Traill et al. 2010 at 29).

The Service, in their final rule listing the streaked horned lark and Taylor's checkerspot butterfly, considered both species at risk due to small population size or small, isolated populations (USFWS 2013a at 61,489).

> Populations that are small, fragmented, or isolated by habitat loss or modification of naturally patchy habitat, and other human-related factors, are more vulnerable to extirpation by natural, randomly occurring events, to cumulative effects, and to genetic effects that plague small populations, collectively known as small population effects. These effects can include genetic drift (loss of recessive alleles), founder effects (over time, an increasing percentage of the population inheriting a narrow range of traits), and genetic bottlenecks leading to increasingly lower genetic diversity, with consequent negative effects on evolutionary potential. (*Id*. at 61,488)

The Service found similar threats when listing the Florida bonneted bat:

> In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in low diversity, which may impact viability and fecundity. Distance between subpopulations or colonies, the small sizes of colonies, and the general low number of bats may make recolonization unlikely if any site is extirpated. Isolation of habitat can prevent recolonization from other sites and potentially result in extinction. The probability of extinction increases with decreasing habitat availability. Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population (i.e., the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval). If populations become fragmented, genetic diversity will be

[5] For examples, see candidate assessment forms for *Ostodes strigatus* (Sisi snail, June 2013), *Porzana tabuensis* (spotless crake, June 2013), *Vagrans egistina* (Mariana wandering butterfly, June 2013), *Gallicolumba stairi* (friendly ground-dove, June 2013), and *Hyla wrightorum* (Arizona treefrog, April 2013) (ecos.fws.gov/tess_public/pub/SpeciesReport.do?listingType=C&mapstatus=1).

> lost as smaller populations become more isolated. (USFWS 2013b at 61037, *internal citations omitted*)

The Rio Grande sucker has small, isolated populations and fragmented habitat, and thus is facing a similar risk of extinction.

Cumulative threats. The Service should consider whether the array of aforementioned threats intersect and act synergistically, therefore increasing the likelihood of extinction or endangerment of the Rio Grande sucker in the foreseeable future. "For most endangered and threatened fish species, one or two principal causes of their distress are emphasized, but their status is typically the result of multiple, cumulative long-term effects" (Moyle and Leidy 1992 at 158). For example, sedimentation may limit the amount of periphyton available as a food resource, which increases competition with introduced white suckers, decreasing the number and condition of Rio Grande suckers (Swift-Miller et al. 1999a at 155). These are just examples of intersecting threats facing the Rio Grande sucker.

> Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates. (Brook *et al*. 2008 at 455, *internal citations omitted*)

> [O]nly by treating extinction as a synergistic process will predictions of risk for most species approximate reality, and conservation efforts therefore be effective. However challenging it is, policy to mitigate biodiversity loss must accept the need to manage multiple threatening processes simultaneously over longer terms. Habitat preservation, restoring degraded landscapes, maintaining or creating connectivity, avoiding overharvest, reducing fire risk and cutting carbon emissions have to be planned in unison. Otherwise, conservation actions which only tackle individual threats risk becoming half-measures which end in failure, due to uncontrolled cascading effects. (*Id.* at 459, *internal citations omitted*)

REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the U.S. Fish and Wildlife Service under the Department of the Interior to list the Rio Grande sucker (*Catostomus plebeius*) as an "endangered" or "threatened" species under the Endangered Species Act. Listing is warranted, given the species' protracted decline in population size and distribution during the twentieth century. The Rio Grande sucker is threatened by at least three of the five listing factors under the ESA: present and threatened destruction, modification and curtailment of habitat and range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence. WildEarth Guardians also requests that critical habitat be designated for the Rio Grande sucker in occupied and suitable unoccupied habitat as appropriate and concurrent with the final ESA listing. Designating critical habitat for this species would not only support its recovery and allow for recolonization of its former range but would also aid in the protection of the Rio Grande ecosystem and constituent biota.

REFERENCES

Abarca, F. J., Young, K. L., Parra, I., Bettaso, R. H., & K. Cobble. 1995. Yaqui River fishes relevant to the Madrean Province: U.S.-México collaborations. In DeBano, L. F., Ffolliott, P. H., Ortega-Rubio, A., Gottfried, G. J., Hamre, R. H., & Edminster, C. B. (technical coordinators), *Biodiversity and Management of the Madrean Archipelago: The Sky Islands of Southwestern United States and Northwestern México* (pp. 370-378). General Technical Report RM-GTR-264. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.

Barnett, T. P., Pierce, D. W., Hidalgo, H. G., Bonfils, C., Santer, B. D., Das, T., Bala, G., Wood, A. W., Nozawa, T., Mirin, A. A., Cayan, D. R., & Dettinger, M. D. (2008). Human-induced changes in the hydrology of the western United States. *Science 319*, 1080-1083. Retrieved from http://tenaya.ucsd.edu/~dettinge/barnett08.pdf

Bestgen, K. R., Compton, R. I., Zelasko, K. A., & Alves, J. E. (2003). Distribution and status of Rio Grande chub in Colorado. *Larval Fish Laboratory Contribution 135*. Fort Collins, CO: Larval Fish Laboratory, Department of Fishery and Wildlife Biology, Colorado State University. Retrieved from http://warnercnr.colostate.edu/docs/fwcb/lfl/PDF/LFL-135-Bestgen_et_al-2003-Rpt.pdf

Biota Information System of New Mexico [BISONM] (2013). *Rio Grande sucker.* New Mexico Game and Fish and Natural Heritage New Mexico. Retrieved from http://www.bison-m.org/booklet.aspx?id=010515#ref25

Brook, B., Sodhi, N., & Bradshaw, C. (2008). Synergies among extinction drivers under global change. *Trends in Ecology and Evolution, 23*(8), 453-460.

Bullard, T. F., & Wells, S. G. 1992. Hydrology of the Middle Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. *U.S. Fish and Wildlife Service Resource Publication 179*. Washington, D.C. Retrieved from http://www.fws.gov/southwest/mrgbi/Resources/Dams/#top

Bureau of Land Management (BLM) (2008). *Manual 6840: Special Status Species Management Manual for the Bureau of Land Management*. Washington, D.C.: Bureau of Land Management.

Bureau of Reclamation (BOR) (2011). *SECURE Water Act Section 9503(c)—Reclamation Climate Change and Water, Report to Congress*. Retrieved from http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf

Calamusso, B. (2005). Fishes of Southwestern Grasslands: Ecology, Conservation, and Management. In Finch, D. M. (Ed.), *Assessment of Grassland Ecosystem Conditions in the Southwestern United States (Vol. 2)* (pp. 141-168). General Technical Report RMRS-GTR-135-vol. 2. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from http://www.fs.fed.us/rm/pubs/rmrs_gtr135_2.html

Calamusso, B., & Rinne, J. N. (1999) Native fishes of the middle Rio Grande ecosystem: status, threats, and conservation. In Finch, D. M., Whitney, J. C., Kely, J. F., & Loftin, S. R. (Eds.), *Rio Grande Ecosystems: Linking Land, Water, and People. Toward a Sustainable Future for the Middle Rio Grande Basin* (pp. 231-237). Proc. RMRS-P-7. USDA Forest Service, Rocky Mountain Research Station.

___. 1996. Distribution of the Rio Grande cutthroat trout and its co-occurrence with the Rio Grande sucker and Rio Grande chub on the Carson and Santa Fe National Forests. In Shaw, D. W., & Finch, D. M. (technical coordinators), *Desired Future Conditions for Southwestern Riparian Ecosystems: Bringing Interests and Concerns Together* (pp. 157-167). General Technical Report RM-GTR-272. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.

Calamusso, B., Rinne, J. N., & Turner, P. R. (2002). Distribution and abundance of the Rio Grande sucker in the Carson and Santa Fe National Forests, New Mexico. *The Southwestern Naturalist 47*(2), 182-186.

Caughley, G. (1994). Directions in conservation biology. *Journal of Animal Ecology, 63*(2), 215-244.

Cohen, A. E., Labay, B. J., Hendrickson, D. A., Casarez, M., & Sarkar, S. (2013). *Final report: data provision and projected impact of climate change on fish biodiversity within the Desert LCC.* Submitted to United States Department of the Interior, Bureau of Reclamation, Desert Landscape Conservation Cooperative. Agreement Number: R11AP81527. Austin, TX: University of Texas at Austin. Retrieved from http://hdl.handle.net/2152/22475

Colorado Parks and Wildlife (CPW) (2006). New population of Rio Grande sucker found. *Colorado Parks and Wildlife press release*. Retrieved from http://dnr.state.co.us/newsapp/press.asp?pressid=3732

Colorado Water Conservation Board (CWCB) (2012). *Status of Instream Flow and Natural Lake Appropriations.* Retrieved from http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=168131&dbid=0

Contreras-Balderas, S., Almada-Villela, P., Lozano-Vilano, M. de L., & García-Ramírez, M. E. (2003). Freshwater fish at risk or extinct in México. *Reviews in Fish Biology and Fisheries 12*, 241-251.

Cope, E. D., & Yarrow, H. C. (1875). Report upon the collections of fishes made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-1874. *United States Army Engineers Department Report 5*, 635-703.

Dahm, C. N., Edwards, R. J., & Gelwick, F. P. (2005). Gulf Coast rivers of the southwestern United States. In Benke, A. C., & Cushing, C. E. (Eds.), *Rivers of North America* (pp.

181-230). Burlington, MA: Elsevier Academic Press.

Dudley, R. K., & Platania, S. P. (2007). Flow regulation and fragmentation imperil pelagic-spawning riverine fishes. *Ecological Applications 17*(7), 2074-2086.

Ellis, M. M. (1914). Fishes of Colorado. *University of Colorado Studies 11*(1), 5-135.

Environmental Protection Agency (EPA) (1998). *National Water Quality Inventory: 1998 Report to Congress.* Washington, D.C.: U.S. Environmental Protection Agency. Retrieved from http://water.epa.gov/lawsregs/guidance/cwa/305b/98report_index.cfm

Hammerson, G., & Clausen, M. K. (2013). *Catostomus plebeius*—Baird and Girard, 1854. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Arlington, VA: NatureServe. Retrieved from http://explorer.natureserve.org

Hampe, A., & Petit, R. J. (2005). Conserving biodiversity under climate change: the rear edge matters. *Ecology Letters 8*(5), 461-467.

Hendrickson, D. A., Minckley, W. L., Miller, R. R., Siebert, D. J., & Minckley, P. H. (1980). Fishes of the Río Yaqui Basin, México and the United States. *Journal of the Arizona-Nevada Academy of Science 15*(3), 65-106.

Hoagstrom, C. W., Remshardt, W. J., Smit, J. R., & Brooks, J. E. (2010). Changing fish faunas in two reaches of the Rio Grande in the Albuquerque Basin. *The Southwestern Naturalist 55*(1), 78-88. doi:http://dx.doi.org/10.1894/GG-38.1

Hurd, B. H., & Coonrod, J. (2007). Climate change and its implications for New Mexico's water resources and economic opportunities. Proceedings from New Mexico Water Conference '07: *Beyond the Year of Water: Living Within Our Water Limitations*. Las Cruces, NM: New Mexico Water Resources Research Institute, New Mexico State University. Retrieved from http://agecon.nmsu.edu/bhurd/hurdhome/index.htm

Jelks, H. L., Walsh, S. J., Burkhead, N. M., Contreras-Balderas, S, Diaz-Pardo, E., Hendrickson, D. A., Lyons, J., Mandrak, N. E., McCormick, F, Nelson, J. S., Platania, S. P., Porter, B. A., Renaud, C. B., Schmitter-Soto, J. J., Taylor, E. B. & Warren, M. L. (2008). Conservation status of imperiled North American freshwater and diadromous fishes. *Fisheries 33*, 372-407.

Johnson, N. K., & DuMars, C. T. (1989). A survey of the evolution of Western water law in response to changing economic and public interest demands. *Natural Resources Journal 29*, 347-387.

Jordan, D. S. (1891). Report of explorations in Colorado and Utah during the summer of 1889, with an account of the fishes found in each of the river basins examined. *Bulletin of the United States Fish Commission 9*, 1-40.

Koster, W. J. (1957). *Guide to the Fishes of New Mexico.* Albuquerque, NM: University of New Mexico Press.

Langlois, D., Alves, J., & Apker, J. (1994). *Rio Grande Sucker Recovery Plan.* Montrose, CO: Colorado Division of Wildlife.

Lewis, S. (2007). Some suckers deserve an even break. *Colorado Central Magazine.* Retrieved from http://cozine.com/2007-may/some-suckers-deserve-an-even-break/

Loarie, S. R., Duffy, P. B., Hamilton, H, Asner, G. P., Field, C. B., & Ackerly, D. D. (2009). The velocity of climate change. *Nature 462*, 1052-1055.

Lozano-Vilano, Ma. de Lourdes (2010). Recent records of *Cycleptus* in the Río Conchos, Chihuahua, México. *The Southwestern Naturalist 55*(2), 284-286. doi:http://dx.doi.org/10.1894/GG-31.1

McPhee, M. V. (2007). Age, growth, and life history comparisons between the invasive white sucker (*Catostomus commersoni*) and native Rio Grande sucker (*C. plebeius*). *The Southwestern Naturalist 52*(1), 15-25.

McPhee, M. V., & Turner, T. F. (2004). No genetic evidence for hybridization between Rio Grande sucker, *Catostomus plebeius*, and the introduced white sucker, *Catostomus commersoni*, in the Rio Grande. *Environmental Biology of Fishes 71*(1), 85-93.

Meyer, J. L., Sale, M. J., Mulholland, P. J., & Poff, N. L. (1999). Impacts of climate change on aquatic ecosystem functioning and health. *Journal of the American Water Resources Association 35*(6), 1373-1386.

Miller, R. R. (2005). *Freshwater Fishes of México*. Chicago and London: University of Chicago Press.

Montana Department of Natural Resources and Conservation (MTDNRC) (2012). Water Conversion Table. Form No. 615 R03/2012. Retrieved from http://www.dnrc.mt.gov/wrd/water_rts/wr_general_info/wrforms/wr_forms.asp

Moyle, P. B., & Leidy, R. A. (1992). Loss of Biodiversity in Aquatic Ecosystems: Evidence from Fish Faunas. In Fielder, P. L., & Jain, S. K. (Eds.), *Conservation Biology: The Theory and Practice of Nature Conservation, Preservation and Management* (pp. 126-169). New York, NY: Routledge, Chapman & Hall, Inc.

National Resources Committee (NRC) (1938). *Regional Planning Part IV—The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936-1937*. Washington, D.C.: United States Government Printing Office.

Natural Heritage New Mexico (NHNM) (2014). *Definitions of New Mexico Natural Heritage Program Ranks of Endangerment.* IM08c_Status&Rank_DefinitionsNewShorter.doc. V. 2014-04-18 P. Retrieved from http://nhnm.unm.edu/pdf/ranks_status.pdf

_____ (2002). *Conservation status information: Catastomus plebeius.* Retrieved from http://nhnm.unm.edu/query_bcd/state_rank.php5?id=404662

New Mexico Department of Game and Fish (NMDGF) (2006). *Comprehensive Wildlife Conservation Strategy for New Mexico.* Santa Fe, NM: New Mexico Department of Game and Fish.

Norma Oficial Mexicana NOM-059-ECOL-2001, *Protección ambiental—Especies nativas de México de flora y fauna silvestres—Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio—Lista de especies en riesgo.*

Page, L. M., & Burr, B. M. (2011). *Peterson Field Guide to Freshwater Fishes of North America North of México.* Second edition. Boston, MA: Houghton Mifflin Harcourt.

Paskus, L. (2014, September 17) Minnow down: WildEarth Guardians suits up for another battle on the Rio Grande. *Santa Fe Reporter*. Retrieved from http://www.sfreporter.com/santafe/article-9198-minnow-down.html

Patton, G. (2003). *Region 2 Sensitive Species List. Rio Grande Sucker* (Catostumus plebeius) *Recommendation Rationale: R2 Sensitive Species.* USDA Forest Service Region 2. Retrieved from http://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5390116

Pederson, G. T., Graumlich, L. J., Fagre, D. B., Kipfer, T., & Muhlfeld, C. C. (2010). A century of climate and ecosystem change in western Montana: what do temperature trends portend? *Climatic Change 98*(1-2), 133-154.

Rees, D. E., & Miller, W. J. (2005). *Rio Grande Sucker (*Catostomus plebeius*): A Technical Conservation Assessment.* USDA Forest Service, Rocky Mountain Region. Retrieved from http://www.fs.fed.us/r2/projects/scp/assessments/riograndesucker.pdf

Rees, D.E., Carr, R. J., & Miller, W. J. (2005). *Rio Grande Chub (*Gila pandora*): A Technical Conservation Assessment.* USDA Forest Service, Rocky Mountain Region. Retrieved from http://www.fs.fed.us/r2/projects/scp/assessments/riograndechub.pdf

Ricciardi, A., & Rasmussen, J. B. (1999). Extinction rates of North American freshwater fauna. *Conservation Biology 13*, 1220-1222.

Rinne, J. N. (1995). Reproductive biology of the Rio Grande sucker, *Catostomus plebeius* (Cypriniformes), in a montane stream, New Mexico. *The Southwestern Naturalist 40*(2), 237-241.

Rinne, J. N., & Platania, S. P. (1995). Fish fauna. In Finch, D. M. & Tainter, J. A. (Eds.), *Ecology, Diversity, and Sustainability of the Middle Rio Grande Basin* (pp. 165-175). Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-GTR-268.

Sala, O. E., Chapin, F. S., Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L. F., Jackson, R. B., Kinzig, A., Leemans, R., Lodge, D. M., Mooney, H. A., Oesterheld, M., Poff, N. L., Sykes, M. T., Walker, B. H., Walker, M., & Wall, D. H. (2000). Global biodiversity scenarios for the year 2100. *Science 287*, 1770-1774.

Smith, G. R. (1966). Distribution and evolution of the North American catostomid fishes of the subgenus *Pantosteus,* genus *Catostomus. Miscellaneous Publications of the University of Michigan Museum of Zoology 129*, 1-132.

Smith, G. R., Hall, J. G., Koehn, R. K., & Innes, D. J. (1983). Taxonomic relationships of the Zuni mountain sucker, *Catostomus discobolus yarrowi. Copeia 1*, 37-48.

Snyder, D. E. (1979). Myomere and vertebra counts of North American cyprinids and catostomids. In Hoyt, R. D. (Ed.), *Proceedings of the Third Symposium on Larval Fish* (pp. 53-69). Bowling Green, KY: Western Kentucky University.

Swift, S. M. (1996). *Ecology and Conservation of Rio Grande Sucker,* Catostomus plebeius (Master's thesis). Colorado State University, Fort Collins, CO.

Swift-Miller, S. M. (2001). *USDA-Forest Service R2 Sensitive Species Evaluation Form:* Catostomus plebeius*/Rio Grande sucker*. USDA Forest Service, Region 2. Retrieved from http://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5390116

Swift-Miller, S. M., Johnson, B. M., & Muth, R. T. (1999a). Factors affecting the diet and abundance of northern populations of Rio Grande sucker (*Catostomus plebeius*). *The Southwestern Naturalist 44*(2), 148-156.

Swift-Miller, S. M., Johnson, B. M., Muth, R. T., & Langlois, D. (1999a). Distribution, abundance, and habitat use of Rio Grande sucker (*Catostomus plebeius*) in Hot Creek, Colorado. *The Southwestern Naturalist 44*(1), 42-48.

Sublette, J. E., Hatch, M. D., & Sublette, M. S. (1990). *The Fishes of New Mexico.* Albuquerque, NM: University of New Mexico Press.

Traill, L. W., Brook, B. W., Frankham, R. R., & Bradshaw, C. (2010). Pragmatic population viability targets in a rapidly changing world. *Biological Conservation 143*, 28-34.

Turner, T. F., Krabbenhoft, T. J., & Burdett, A. S. (2010). Reproductive Phenology and Fish Community Structure in an Arid-Land River System. *American Fisheries Society Symposium 73*, 427–446.

U.S. Fish and Wildlife Service (USFWS) (2013a). Endangered species status for the Florida bonneted bat: final rule. *Federal Register 78*(191), 61,004-61,043.

_____ (2013b). Determination of endangered status for the Taylor's checkerspot butterfly and threatened status for the streaked Horned Lark: final rule. *Federal Register 78*(192), 61,452-61,503.

_____ (2012). *U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form:* Oncorhynchus clarki virginalis*.* Washington, D.C.: USDI Fish and Wildlife Service.

_____ (2008). Status review for Rio Grande cutthroat trout. *Federal Register 73*(94), 27,900-27,926.

_____ (1994). *Yaqui Fishes Recovery Plan*. Albuquerque, NM: USDI Fish and Wildlife Service.

U.S. Forest Service (USFS) (2013). *USFS R3 Regional Forester's Sensitive Species: Animals—2013.* USDA Forest Service, Region 3. Retrieved from http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_021328.pdf

_____ (2005). *Forest Service Manual 2600—Wildlife, Fish, and Sensitive Plant Habitat Management. Chapter 2670—Threatened, Endangered and Sensitive Plants and Animals.* Washington D.C.: USDA Forest Service.

White, J. A. (1972). *Food and feeding habits of the Rio Grande mountain-sucker,* Pantosteus plebeius *(Baird and Girard)* (Unpublished master's thesis). University of New Mexico, Albuquerque, NM.

Wong, C. M., Williams, C. E., Pittock, J., Collier, U., & Schelle, P. (2007). *World's Top 10 Rivers at Risk.* Gland, Switzerland: World Wildlife Fund International. Retrieved from http://www.unwater.org/downloads/worldstop10riversatriskfinalmarch13_1.pdf

Zeigler, M. P., Todd, A. S., & Caldwell, C. A. (2012) Evidence of recent climate change within the historic range of Rio Grande cutthroat trout: implications for management and future persistence. *Transactions of the American Fisheries Society 141*(4), 1045-1059. doi:10.1080/00028487.2012.676589