U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT
AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Gila pandora*

COMMON NAME: Rio Grande chub

LEAD REGION: Region 2

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DATE INFORMATION CURRENT AS OF: May 9, 2024

STATUS/ACTION

_X_ Species petitioned for listing which we have determined does not warrant listing (does not meet the definition of a threatened or endangered species)

Petition Information:

_X_ Petitioned; Date petition received: September 27, 2013
90-day "substantial" finding FR publication date; citation: March 6, 2016; 81 FR 14058

PREVIOUS FEDERAL ACTIONS:

On September 27, 2013, the U.S. Fish and Wildlife Service (Service) received a petition from the WildEarth Guardians to list the Rio Grande chub as an endangered or threatened species under the Endangered Species Act (Act) and designate critical habitat (WildEarth Guardians 2013, entire). On March 6, 2016, we published a 90-day finding (81 FR 14058) that the petition contained substantial information indicating listing may be warranted for the species. This document constitutes our 12-month finding on the September 27, 2013 petition to list the Rio Grande chub under the Act.

ANIMAL GROUP AND FAMILY: Fish, Cyprinidae

ANALYTICAL FRAMEWORK

To assess the Rio Grande chub's viability, we conducted a species status assessment (SSA) using the three conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 306–311). Briefly, resiliency supports the ability of the species to withstand environmental and demographic stochasticity (for example, wet or dry, warm or cold years, variation in demographic rates), redundancy supports the ability of the species to withstand catastrophic events (for example, droughts, large pollution events), and representation supports the ability of the species to adapt to both near-term and long-term changes in its physical and biological environment (for example, climate change, disease). A species with a high degree of resiliency, representation, and redundancy is better able to adapt to novel changes and to tolerate environmental stochasticity and catastrophes. In general, species viability will increase with increases in resiliency, redundancy, and representation (Smith et al. 2018, p. 306). Using these principles, we identified the species' ecological requirements for survival and reproduction at the individual, population, and species levels, and described the beneficial and risk factors influencing the species' viability.

We use the SSA framework to assemble the best scientific and commercial data available for this species. The SSA framework consists of three sequential stages. During the first stage, we evaluate the species' needs. The next stage involves an assessment of the historical and current condition of the species' demographics and habitat characteristics, including an explanation of how the species arrived at its current condition (i.e., how threats and conservation actions have influenced the species). The final stage of the SSA framework involves assessing the species' plausible range of future responses to positive and negative environmental and anthropogenic influences. The SSA framework uses the best available information to characterize viability as the ability of a species to sustain populations in the wild over time and is used to inform our regulatory decision.

The SSA Report does not represent a decision by the Service on whether the Rio Grande chub should be listed under the Act. However, it does provide the scientific basis that informs our regulatory decisions, which involve the further application of standards within the Act and its implementing regulations and policies. The Species Status Assessment Report for the Rio Grande chub – June 2024, Version 1.2 (SSA Report) is a summary of the information we have assembled and reviewed and incorporates the best scientific and commercial data available for this species. Excerpts of the SSA Report are provided in the sections below. For more detailed information, please refer to the SSA Report (Service 2024, entire).

BIOLOGICAL INFORMATION

The Rio Grande chub is a small freshwater fish found predominantly in montane stream environments. Its historical range included the upper Rio Grande basin in north-central New Mexico and south-central Colorado. Its historical range also includes portions of the Canadian

River basin in New Mexico and the Pecos River basin in New Mexico and Texas (Figure 1). The Rio Grande chub now occupies a small portion of its historical range in fragmented populations. Its distribution has contracted by as much as 75 percent in parts of the Rio Grande Basin (Rees et al. 2005, p. 10). Now restricted to tributary streams, the Rio Grande chub is largely absent from mainstem rivers except for the mainstem Rio Grande in northern New Mexico and southern Colorado. Based on information such as genetic and ecological differences, watershed boundaries, and management regimes, fishery managers have divided the range of the Rio Grande chub into six Geographic Management Units (GMUs)(Figure 1). Most of the Rio Grande chub's historical and contemporary range are in the northern GMUs within the Rio Grande basin: the Rio Grande-Headwaters and Rio Grande-Elephant Butte. Dispersal and gene flow between Rio Grande chub populations occupying different drainage basins is non-existent, meaning they function as biologically independent units. This also means that the likelihood of threats associated with water and hydrological connectivity (e.g., nonnative species colonization, water withdrawal) differs between these basins.

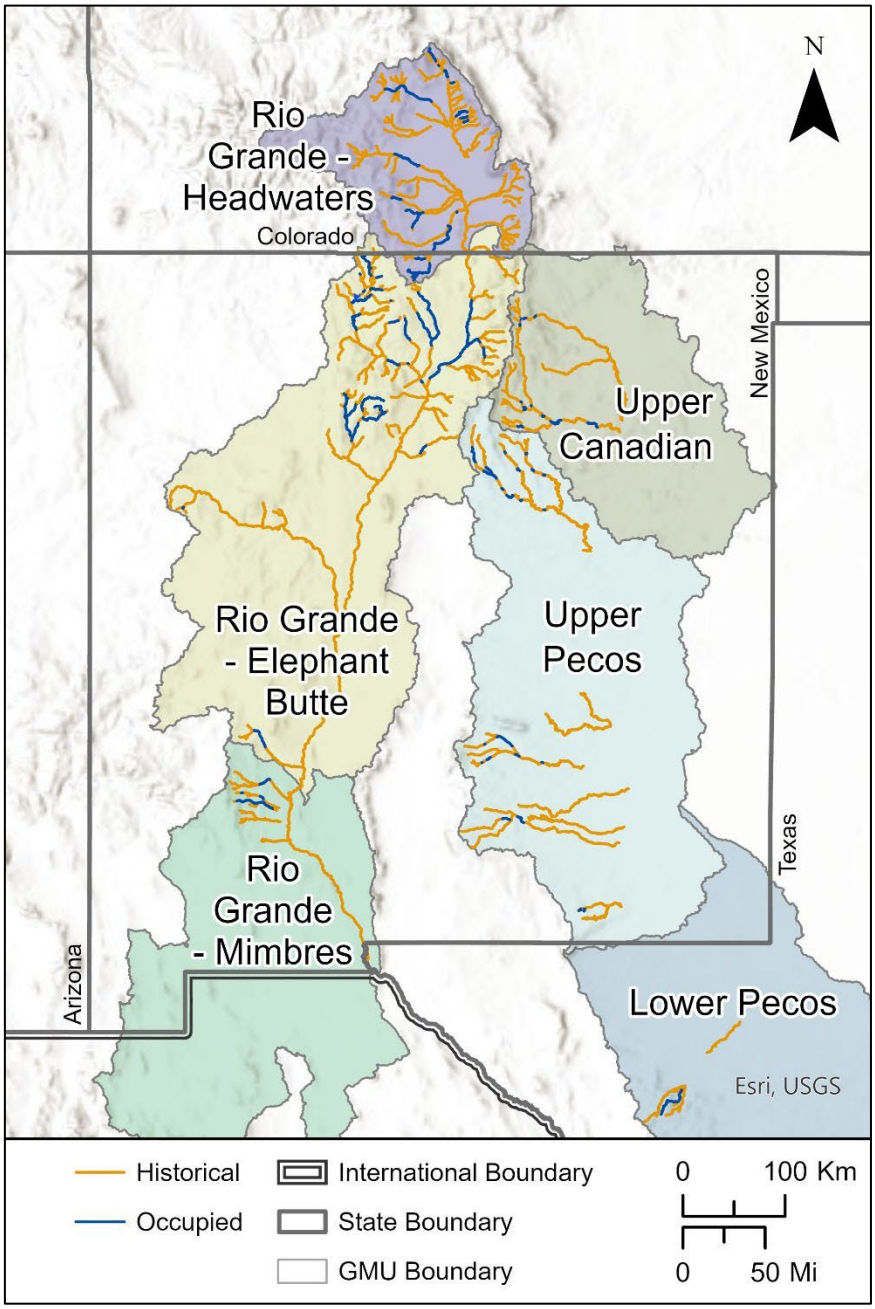

Figure 1: Historical and current distribution of Rio Grande chub in the United States, based on records of currently occupied stream segments compiled by the Rio Grande Chub and Sucker Conservation Team. Occupancy is defined as habitats occupied by Rio Grande chub as of 2000 (Rio Grande Chub and Sucker Range-wide Conservation Working Group 2018, p. 2). Overlaid are the Geographical Management Units (GMUs) used by the Conservation Team.

A phylogenetic analysis conducted on *Gila* species found in Mexico and the western United

States found that the Rio Grande chub formed a distinct, well supported clade compared to other species in the genus (Schönhuth et al. 2014, entire). However, *Gila modesta*, a species with a small range in Mexico, clustered within this same clade. As there are no other *Gila* populations between these two groups, Schönhuth et al. (2014, p. 221) proposed that these populations could be morphologically different groups of the same species, emerging species, or different species that have not yet become genetically different. To be taxonomically inclusive, we are including *Gila modesta* in our assessment of *Gila pandora*. This species is currently only present in Arroyo Los Chorros, a spring system located in the Rio San Juan near the city of Saltillo in the state of Coahuila (Contreras-Balderas 1991, p. 197; Miller 2005, p. 124; Lozano-Vilano et al. 2020, pp. 83–84).

Found in a variety of aquatic habitats, the Rio Grande chub is associated with low gradient streams that may experience substantial variation in annual environmental conditions. Streams occupied by this species tend to have low to moderate water flow, low water depths, and a large temperature range. Like other chub species, the Rio Grande chub is often associated with instream structures. Large woody debris, boulders, rip-rap, undercut banks, and aquatic vegetation are commonly correlated with Rio Grande chub presence (Calamusso and Rinne 1996, p. 159; Bestgen et al. 2003, p. 21). Omnivorous mid-water column feeders, the Rio Grande chub consumes drifting invertebrates, fish, and occasional vegetation for their diet sources.

To maintain viability into the future, the Rio Grande chub requires populations capable of withstanding stochastic disturbances. Resiliency is supported by sufficient resources (e.g., water, habitat) and environmental conditions to maintain natural population dynamics. As a desert fish species inhabiting environments that can fluctuate dramatically over time, Rio Grande chub populations have an inherent resiliency. Many populations experience substantial variation in conditions such as water flows and temperatures. When conditions are more inhospitable, such as during low-water periods, populations may decline in size and spatial extent, and they often rebound when suitable conditions return. Thus, for populations to be resilient, they require the bare minimum resources to persist during extreme periods, followed by sufficient quantity and quality of resources during hospitable periods to facilitate their life history. Most important are minimum amounts of water and temperatures within the species' thermal tolerances. A challenge is that we do not have information on what those minimum resource requirements are during extreme periods, nor thresholds that produce sufficient rebounds that will allow Rio Grande chub to thrive until the next stochastic event.

For Rio Grande chub, water quantity is essential to the survival of individuals as well as populations. There are no known thresholds of minimum flows required to support viable populations of Rio Grande chub. Barkalow et al. (2023, p. 9) recorded stream velocities between 0.03 and 0.99 meters (m) per second (0.1 and 3.24 feet (ft) per second, respectively) in streams where they collected Rio Grande chub. Similarly, information is lacking regarding water quality and its influence on population persistence. The species occurs in a dynamic environment in which water quality can be influenced by events such as flooding during snowmelt and drought,

indicating some tolerance for changes in water quality. However, the location, timing, and duration of these events may impact population dynamics, such as recruitment. For example, since Rio Grande chub spawn over clean gravel substrates, turbidity and fine sediment loads may impact reproduction and recruitment (Rees et al. 2005, p. 16).

Excessively warm water temperatures above the Rio Grande chub's thermal maximums can reduce survival and result in die-offs. The Rio Grande chub has some capacity to tolerate high water temperatures, but there is a threshold at which tolerance is exceeded as several studies indicated an upper limit to the temperature at which Rio Grande chub were not found (Platania 1991, p. 190; Bestgen et al. 2003, p. 26). Access to cool water, particularly during summer months, is vital to limit large-scale mortality that can reduce viability and result in extirpation.

Where resources are sufficient, Rio Grande chub can be locally abundant with high densities (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021a, p. 9). Aquatic environments are dynamic, however, and resources necessary for survival and reproduction can shift in distribution over space and time. Therefore, resiliency is highest in waterways that support multiple suitable habitat patches distributed throughout their length. Importantly, connectivity must be present to allow movement of individuals between suitable habitat patches. This allows access to specific habitats that are preferred for feeding versus those that support reproduction. Also, the presence of multiple, highly connected habitat patches support population dynamics and reduces the risk of extirpation due to stochastic events (Fagan et al. 2002, entire).

Even for resilient populations, some events are so severe that they increase the likelihood of extirpation. Potential catastrophic events affecting the Rio Grande chub include wildfire, dewatering events due to drought or other hydrological forces, and severe water flows that may destroy habitat (Service 2024, pp. 25–43). To mitigate against these events, it is essential that populations be distributed across the species' range to reduce the potential consequences of a single event. Geographic clustering of populations increases the potential for a low number of catastrophes to result in significant extirpations and elevate extinction risk.

Concerning the ability to adapt to changing environmental changes, the Rio Grande chub can disperse to suitable areas as conditions change, display phenotypic plasticity, or evolve in place. Although the Rio Grande chub is a small-bodied fish that has limited ability to move long distances, populations naturally wax and wane throughout a watershed as conditions fluctuate. This provides opportunity for dispersal, meaning that connected waterways, both within and between populations, are important for the species. The Rio Grande chub does display some phenotypic plasticity and genetic diversity rangewide (Service 2024, pp. 23–24), indicating an ability to adapt in place. Maintenance of sufficient population sizes and ecological diversity are critical to ensure the retention of this diversity.

For additional information on the species description, taxonomy, habitat/life history, historical and current range/distribution please refer to pp. 11–18 of the SSA report. For additional information on population and species needs, please refer to pp. 19–43 of the SSA report.

FACTORS INFLUENCING THE STATUS

The Act directs us to determine whether any species is an endangered species or a threatened species because of any factors (or threats) affecting its continued existence (i.e., whether it meets the definition of a threatened species or an endangered species). We use the term "threat" to refer in general to actions or conditions that are known to or are reasonably likely to negatively affect individuals of a species. The term "threat" includes actions or conditions that have a direct impact on individuals, as well as those that affect individuals through alteration of their habitat or required resources. The term "threat" may encompass—either together or separately—the source of the action or condition, or the action or condition itself.

However, the mere identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an "endangered species" or a "threatened species." In determining whether a species meets either definition, we must evaluate all identified threats by considering the expected response by the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Secretary determines whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and (if evaluating whether a species is a threatened species) in the foreseeable future.

Threats, Conservation Measures, and Existing Regulatory Mechanisms

Altered hydrology and habitat fragmentation

The Rio Grande chub requires water as a basic habitat component for survival. Anthropogenic activities, such as surface water diversions and groundwater withdrawals (i.e., pumping), and construction of impoundments, have the potential to decrease streamflow resulting in direct habitat loss and increased habitat fragmentation. Habitat loss can decrease growth, reproductive success, and survival rates of the Rio Grande chub (Grover 2019, p. 184). Habitat fragmentation can have negative effects on species by reducing habitat complexity and connectivity, reducing genetic diversity, and increasing the possibility of extinction. The creation of isolated populations due to fragmented habitats can lead to greater vulnerability to environmental pressures, such as disease outbreaks and local disturbances. Water diversions are common across

the species range: there are 248 water diversion structures within the range of the Rio Grande chub. Groundwater pumping is most prevalent in the San Luis Valley in southern Colorado, affecting populations in the Rio Grande-Headwaters GMU. Exposure to these activities is population-specific and the impacts to populations can be variable, depending on the amount of water removed and the presence of other resources (e.g., habitat complexity) that would facilitate persistence. More detailed information on the effects of altered hydrology and habitat modification on the Rio Grande chub and its habitat are in the SSA Report (Service 2024, pp. 25–29).

In-stream barriers are common across the range of Rio Grande chub: there are 116 known barriers within its current range (Service 2024, p. 30). Some may be impassible, while others may be passable only during high flows. Types of barriers include dewatered areas and thermal barriers. These barriers can prevent upstream movement of Rio Grande chub, reducing connectivity between populations. This can affect genetic diversity and limit adaptive capacity. However, barriers can also have beneficial effects, preventing immigration of nonnative species. Thus, the effects of a barrier can be variable, depending on the quality and quantity of habitat available to a population and potential exposure to nonnative species. More detailed information on the effects of barriers on the Rio Grande chub and its habitat are in the SSA Report (Service 2024, pp. 25–29).

Wildfire

Pre-European settlement, wildfires were common but less severe in the western United States (Doerr and Santín 2016, p. 4; Kolden et al. 2017, p. 3). Post-European settlement practices, such as fire suppression, logging, and grazing, have increased western wildfire severity and size. Since the 1970s western wildfires have increased in size and severity, due to higher temperatures, earlier snowmelt, and prolonged drought (Westerling et al. 2006, p. 942; Westerling 2016, pp. 5–6, 8). The Southwest fire season starts earlier and lasts longer, coinciding with warmer temperatures (Westerling 2016 pp. 7, 10). Climate change models predict increased droughts in the southwest, potentially worsening wildfire impacts (Gershunov 2013, pp. 137–138; Abatzoglou and Williams, 2016 p. 4).

Wildfires can alter physical, chemical, and biological features of terrestrial and aquatic ecosystems. The extent and duration of these changes depend on factors such as the fire size, severity, pre-existing conditions, and post-fire weather events. Immediate impacts include vegetation loss, which leads to elevated stream temperatures (Dunham et al. 2007, p. 342). Post-fire erosion, ash deposition, and increases in organic chemicals also negatively affect aquatic communities. These impacts to streams can result in declines and even extirpation of Rio Grande chub populations. The magnitude of population decline can only be determined on a case-by-case basis depending on how much refugial habitat will be available in each stream, proximity of populations to fires, or the severity of each wildfire. Not all populations are equally exposed to the same likelihood of wildfire. Nevertheless, even within these fire-prone landscapes there is

high habitat complexity that likely provides refugia and enables populations to recolonize from non-affected areas. There have been reported instances of severe population declines and even extirpations due to wildfire. Potential reductions in Rio Grande chub abundance following wildfire were noted for populations in Las Animas Creek (2013 Silver Fire) and Rio Guadalupe (2018 Venado Fire). Possible extirpation may have occurred in North Seco Creek following the 2013 Silver Fire. More detailed information on the effects of wildfire on the Rio Grande chub are in the SSA Report (Service 2024, pp. 30–38).

Nonnative Species

The establishment of nonnative species and the decline of native species within the historical range of the Rio Grande chub is well documented (Propst et al. 1987, p. 409; Platania 1991, p. 189; Rinne and Platania 1995, pp. 165–168; Calamusso and Rinne 1999, p. 231; Bestgen et al. 2003, p. 23; Calamusso et al. 2005, p. 211; Hoagstrom et al. 2010, p. 83). In addition to nonnative piscivorous fish species, several species of nonnative crayfish have been introduced into New Mexico. In the upper, middle, and lower Rio Grande, 87, 64, and 46 percent, respectively, of the sampled species composition was nonnative (Platania 1991, p. 190; Bestgen et al. 2003, p. 15; Calamusso et al. 2005, p. 211). Nonnative species are widespread throughout the Rio Grande basin, although they may not co-occur with all Rio Grande chub populations. Nonnative species are anticipated to continue to expand their distributions in watersheds they have already colonized. Watersheds that have not yet been invaded are expected to remain that way due to barriers and control efforts that have prevented invasion to this point.

The presence of nonnative aquatic species poses a threat to the Rio Grande chub through a variety of mechanisms including competition for resources, hybridization, and predation. Competition with nonnative species, especially brown trout (*Salmo trutta*), is implicated as a primary factor in the decline of Rio Grande chub (Bestgen et al. 2003, p. 32; Rees et al. 2005, p. 10). Competition for resources and indirect changes in behavior can result in direct mortality, reduced abundance, changes in habitat use, and poor body condition. Individual effects can result in reduced survival for all age classes and reduced reproductive success can result in lower population growth rates.

Predation by introduced nonnative fish species such as nonnative trout (e.g., brown trout, rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*)) also impact Rio Grande chub populations. Rio Grande chub lack morphological defenses (e.g., spines), increasing their vulnerability to predation. The elimination of Rio Grande chub in the upper mainstem Rio Grande is attributed to predation by nonnative species (Calamusso et al. 2002, p. 214). Predation can directly decrease the populations of Rio Grande chub. Predators can also attack and injure fish, which can make them more vulnerable to disease or other forms of mortality. When mortality rates increase and recruitment success declines, the population size decreases as individuals are lost and the number of new reproductive adults fails to compensate for the losses. More detailed information on the effects of nonnative species on the Rio Grande

chub is in the SSA Report (Service 2024, pp. 38–41).

Climate Change

The potential effects of climate change on the Rio Grande chub are multi-fold, for climate change has the potential to alter the magnitude and frequency of existing stressors, as well as cause changes in environmental conditions. Air temperatures have generally increased across the range of the Rio Grande chub over the past century and are projected to continue to increase over the next several decades. From 1912 to 2011, the annual average daily temperature in Colorado increased by 0.23 °F (0.13 °C) per decade, while in New Mexico, it increased by 0.18 °F (0.10 °C) per decade (Tebaldi et al. 2012, p. 3). However, since 1970, the rates of increase have increased to 0.48 °F (0.27 °C) and 0.60 °F (0.34 °C) per decade for Colorado and New Mexico, respectively (Tebaldi et al. 2012, p. 5). Average monthly temperatures in the Upper Rio Grande Basin during the 1995 to 2004 period, compared to 1961 to 2000, showed winter increases of 1.5 to 2.5 °C (3.0 to 4.0 °F), while the April through November period increased less than 1.1 °C (2.0 °F) in all months except May (Saunders and Maxwell 2005, pp. 13–14). By the end of the 21st century in the Rio Grande Basin, air temperature is projected to increase between 2.8 to 4.9 °C (5.0 to 8.8 °F) depending on location and emission scenario (Llewellyn and Vaddey 2013 p. 39; Pinson 2013 p. 27; Bureau of Reclamation 2016 p. 7–5). Temperature projections in the Pecos River basin indicate a potential increase ranging from 1.4 to 7.4 °C (2.5 °F to 13.3 °F) (New Mexico Interstate Stream Commission 2018 p. 99).

Precipitation has decreased over the same time period and is projected to continue doing so in the future. From 1971 to 2012 in the Pecos River basin, precipitation decreased significantly in every month except for July and October, which had no statistically significant changes, and March and December, which both saw statistically significant increases (New Mexico Interstate Stream Commission 2018, p. 24). The overall trend in precipitation indicated a reduction of about 0.79 in (2 cm) per decade in annual precipitation totals, adding up to over 3 in over the time period (New Mexico Interstate Stream Commission 2018 p. 24). No long-term trend in annual precipitation has been detected in the Upper Rio Grande Basin (Llewellyn and Vaddey 2013 p. 37). Projections suggest a gradual decrease in mean-annual precipitation throughout the 21st century, with climate forecasts suggesting variability in annual precipitation and an expected decline between 2.3 and 4.8 percent (Llewellyn and Vaddey 2013 p. 37; Pinson 2013 p. 33; Bureau of Reclamation 2016 p. 7–5).

Changes in temperature and precipitation patterns are expected to negatively influence snowpack. Projected changes in temperature, precipitation, and snowpack are expected to alter both the magnitude and timing of runoff. All these factors increase the risk of drought, which will continue to increase the future (Ault et al. 2016, pp. 2–5). Reduced water flows, higher water temperatures, and changes in water quality resulting from drought conditions negatively affect the survival and reproduction of native fish species. However, we do not have specific data documenting these effects on the Rio Grande chub. More detailed information on the effects of

climate change on the Rio Grande chub are in the SSA Report (Service 2024, pp. 41–43).

Other Threats

Fish species are generally susceptible to a variety of diseases which have the potential to impact their reproduction, growth, and survival. In addition, drought conditions can cause physiological stress on fish, making them more vulnerable to diseases. Concentration of fish into physically smaller pools can also increase disease risk (Lymbery et al. 2020, entire). However, the impact of disease on Rio Grande chub populations is not well documented. Currently the best available science does not suggest diseases pose a threat to the viability of Rio Grande chub.

Rio Grande chub have been reported to hybridize with native longnose dace (Barkalow et al. 2023, pp. 9, 16; Suttkus and Cashner 1981, p. 78). Both species are native to the Rio Grande basin but introgression appears to be rare. Currently the best available science does not suggest hybridization poses a threat to the viability of Rio Grande chub.

Conservation Measures and Existing Regulatory Mechanisms

Rio Grande chub conservation efforts have occurred for several decades. These conservation efforts include population and habitat monitoring, population restoration, broodstock development, nonnative species removal, and habitat improvements (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021a, pp. 18–19).

A formal conservation agreement for Rio Grande chub and Rio Grande sucker (hereafter referred to as the "Agreement") was finalized in 2018 and species-specific conservation strategies were adopted in 2021 (Rio Grande Chub and Rio Grande Sucker Conservation Team 2018, entire, 2021a, entire, 2021b, entire). Signatories to the 2018 Agreement include the Bureau of Land Management (BLM), Coalition of Colorado Counties, Colorado Parks and Wildlife, Jicarilla Apache Nation, the Intermountain Region of the National Park Service (NPS), New Mexico Department of Game and Fish, Pueblo of Santa Ana, Texas Parks and Wildlife Department, Turner Enterprises, Inc., the U.S. Fish and Wildlife Service, and the U.S. Forest Service (USFS). Taos Pueblo signed as a signatory in 2020. The Fishes of Texas Project, Rio Grande Water Conservation District, and Trout Unlimited New Mexico Council are supporting organizations.

The overall goal of the Agreement is to implement conservation measures to reduce or eliminate threats to Rio Grande chub and reduce the likelihood of extinction. The Agreement also provides a framework for long-term conservation and identifies seven strategic objectives; (1) identify and characterize populations and habitats; (2) secure and enhance populations; (3) restore populations; (4) secure and improve watershed conditions; (5) conduct public outreach; (6) share data; and (7) facilitate and improve coordination (Rio Grande Chub and Rio Grande Sucker Conservation Team 2018, pp. 4–5). The conservation strategies establish conservation approaches, measures, and timeframes for each objective. Progress towards goals and objectives

is assessed during the annual team meeting.

Identify and characterize Rio Grande chub populations and habitat

Biological and ecological information is needed to inform and review effectiveness of management actions. Surveys are designed and conducted to collect data on populations (demographics, distribution, genetic diversity) and habitats to detect changes over time. Research and monitoring are implemented to fill information gaps and to determine conservation needs, habitat requirements, life history parameters, and threats. Characterizing populations provides information on vulnerability to risk factors such as genetic diversity, stream drying, disease, increased water temperatures, and nonnative species. A total of 24 and 32 Rio Grande chub waters were surveyed in 2020 and 2021, respectively (New Mexico Department of Game and Fish 2021, p. 1; Colorado Parks and Wildlife 2022, p. 1), indicating that the Conservation Team has been successful in gathering data to inform the status of the species. Data from these surveys were the primary source of information for our SSA. The Conservation Team has also collected data that informed research on the genetic status of Rio Grande chub populations (Service 2021, entire).

Secure and enhance all known populations

This objective addresses the risks associated with nonnative species. Approaches include restricting stocking of nonnative species, suppression or removal of nonnative species, construction of fish barriers to restrict nonnative fish movement, maintenance of captive populations; restricting the spread of disease and invasive species; and regulating angling and baitfish collection. Fish barriers have been constructed and chemical and mechanical removal efforts conducted to minimize risks associated with nonnative species. In 2020 and 2021 nonnative removal efforts occurred in Comanche and Costilla creeks as part of a Rio Grande cutthroat trout project, Saguache Creek, Las Animas Creek, and Baca National Wildlife Refuge (New Mexico Department of Game and Fish 2021, p. 2; Colorado Parks and Wildlife 2022, p. 2).

Rio Grande chub broodstock from Roaring Fork Pond (year established, 2008), Hot Creek (2008), Rio San Antonio (2002), Saguache Creek (2005), Crestone Creek (2006), Hot Springs Canyon (2004), and San Luis Creek (2005) are held at the J.W. Mumma Native Aquatic Species Restoration Facility in Colorado (Service 2021, p. 19). These captive populations are robust and sustained for over 15 years and have been used to reintroduce or augment wild populations, although many of these broodstocks have low effective population sizes (Service 2021, p. 21).

Transportation of live game fish and the use of baitfish in fishing activities are outlined in state and tribal fishing regulations. The use of Rio Grande chub as baitfish is prohibited in New Mexico and Colorado (New Mexico Administrative Code 19.31.10.14 and CPW Regulations, Chapter 1, Article I, #104(H)(2)). Additionally, harassment, taking or possession of Rio Grande chub is prohibited in Colorado, as stated in CPW Regulations, Chapter 10, Article I, #1000(A).

In Texas, regulations pertaining to the protection of threatened and endangered, as well as non-game species, are established in 31 Texas Administrative Code (TAC) §65.171 and 31 TAC Ch 57E.

Restore populations

This objective addresses species redundancy by establishing new, highly resilient, genetically diverse, and securing populations distributed among the GMUs. Large, complex populations across the range provide geographic representation and reduce the likelihood that catastrophic events will result in widespread extirpations. The Conservation Team has committed to restore between seven and ten new populations during the 10-year agreement (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021a p. 40).

Rio Grande chub reintroductions have been attempted in the Rio San Antonio, and Rock and San Luis creeks in Colorado (Wetland Dynamics LLC 2019, p. 207). Colorado Parks and Wildlife annually stocked hatchery-raised Rio Grande chub into the mainstem of the upper Rio Grande from 2002 to 2019 (except 2015) however, establishment of a self-sustaining population has yet to be documented (Calamusso et al. 2005 p. 216; Rio Grande Chub and Sucker Range-wide Conservation Working Group 2018, entire).

Secure and improve watershed conditions

Improvement and protection of habitat serves to maintain and increase resiliency of populations in changing climatic conditions. Approaches may include instream and riparian habitat restoration and grazing, timber, and land management practices that secure or improve habitat quality, updating of management plans to address threats to habitat, conducting habitat surveys using a standardized monitoring protocol, development of a fire and drought contingency plan (i.e., population salvage following catastrophic events), and working to secure sufficient instream flows. Improving watershed conditions may reduce the risk of wildfire and associated effects of ash flow runoff. For example, 20 waterways were targeted for habitat improvements projects in 2020 alone (New Mexico Department of Game and Fish 2021, p. 2). The Jicarilla Apache Nation, BLM-Colorado, and the NPS updated natural resource management plans that emphasize enhancing habitat and watershed conditions for Rio Grande chub. Colorado Parks and Wildlife has worked with landowners to secure water flows for populations affected by drought.

Conduct public outreach

Public outreach advances conservation efforts by disseminating information, including the status of native fish species, ongoing restoration efforts, and pertinent regulations. By providing this information, public outreach can effectively educate individuals and generate greater support for the conservation of these species. The Conservation Team has developed and distributed outreach materials and conducted outreach programs to inform the public on the biology and

management of the species.

Share data

The Rio Grande Chub Rangewide Database (hereafter "Database") serves as a central data repository for all population and habitat information, restorations, habitat work, and barrier maintenance (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021a, pp. 18, 24). The Database contains current population and habitat data used to produce range-wide status assessments using the most accurate information available (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021a p. 24). The Conservation Team was scheduled to complete a range-wide assessment for Rio Grande chub by 2023 (Rio Grande Chub and Rio Grande Sucker Conservation Team 2018, p. 5), but it has not yet been published. Assessments will be updated every 10 years, or as necessary, and serve as a guide in evaluating conservation efforts.

Facilitate and improve coordination

Signatories participate in an annual meeting to report and review results and changes within individual populations, coordinate monitoring and restoration efforts by developing annual work plans, document progress towards strategy goals, and identify opportunities to collaborate with other native species conservation efforts. This coordination has facilitated complex, multi-partner conservation projects. For example, multi-agency coordination has supported population salvage efforts during periods of low water flows or post-wildfire. Coordination has facilitated at least three population restorations (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021b, p. 18). Addition projects aimed at population restoration and/or habitat enhancement are planned for completion by 2030 (Rio Grande Chub and Rio Grande Sucker Conservation Team 2021b, p. 36–43). Assessment and establishment of captive broodstocks have involved coordination between state and federal agencies. Populating the Database requires extensive coordination and data sharing among partners. The Conservation Team has been successful in promoting coordination and we expect it will continue to improve in the future, enhancing the management options available for the species.

Cumulative Effects

We note that, by using the SSA framework to guide our analysis of the scientific information documented in the SSA report, we have analyzed the cumulative effects of identified threats and conservation actions on the species. To assess the current and future condition of the species, we evaluate the effects of all the relevant factors that may be influencing the species, including threats and conservation efforts. Because the SSA framework considers not just the presence of the factors, but to what degree they collectively influence risk to the entire species, our assessment integrates the cumulative effects of the factors and replaces a standalone cumulative-effects analysis.

ANALYSIS

Our goal was to assess the viability of the Rio Grande chub by projecting the risk of extirpation over time. This analysis involved several components. First, we identified the threats that were mostly likely to result in extirpation of individual populations. These included catastrophic wildfire, nonnative species, and dewatering due to surface water diversion and/or groundwater pumping. Then we estimated the extirpation risk of a population due to each of these threats, which involved a two-step process. First, we estimated the likelihood that a threat may impact the population over a given time frame (Fisheries and Oceans Canada 2016, pp. 4–11)(Table 1). Second, we estimated the magnitude of the impact to that population, (i.e., how much a population will be impacted by a threat)(Table 2).

Table 1: Categories of likelihood of occurrence for threats used in this assessment. Likelihood of occurrence refers here to the probability of a specific threat occurring for a given population over a given time period.

Likelihood of Occurrence	Definition
Known or very likely to occur	This threat has an expected probability of 91-100 percent to occur over the defined time period
Likely to occur	This threat has an expected probability of 51-90 percent to occur over the defined time period
Unlikely	This threat has an expected probability of 11-50 percent to occur over the defined time period
Remote	This threat has an expected probability of 1-10 percent to occur over the defined time period
Unknown	There are no data or prior knowledge of this threat occurring now or in the future.

Table 2: Categories reflecting level of impact to a population from a given stressor. Level of impact refers to the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.

Level of Impact	Definition
Extreme	Severe population decline (e.g., 71-100 percent) with the potential for extirpation.
High	Substantial loss of population (31-70 percent) that would elevate potential for extirpation.
Medium	Moderate loss of population (11-30 percent) that somewhat elevates the potential for extirpation.
Low	Little change in population (1-10 percent) and unlikely to result in extirpation.

In reviewing information on the Rio Grande chub, we concluded that the magnitude of impact is moderated by the biological condition of the population. Thus, magnitude was a composite metric determined by the severity of the threat and the initial resiliency of the population. This reflects the fact that the response of a population to a threat is a product of its initial resiliency and the severity of the effect. We used data obtained from the Database to inform the resiliency of a population based on occupied stream length, relative abundance of adults, population stability, and presence of nonnative species (Service 2024, pp. 47–55). Populations were classified as having high, moderate, or low resiliency, which reflect the potential for the population to persist when confronted with stochastic events. Thus, our estimate of risk incorporates elements of both resiliency and redundancy, as it simultaneously incorporates the conditions of a population and its exposure to major threats to produce a single estimate of extirpation risk.

After estimating the likelihood and magnitude of impact, we categorized risk of extirpation for each population for all three of our primary threats (wildfire, dewatering, nonnatives). There were three risk categories: low, medium, and high (Table 3). For a population to be categorized as low risk, the likelihood of the threat occurring over the given time frame must be remote (less than 10 percent) or the threat would have low magnitude of impact (little population change and no risk of extirpation). That means these populations either have no exposure to major threats or are so robust and resilient that the impacts of those threats would be moderate at worst. Populations categorized as medium risk of extirpation either have less than a 50 percent chance of the threat occurring over the given time frame, or the threat would have a medium impact (i.e., less than 50 percent chance of extirpation from that threat). Thus, medium risk populations are unlikely to be extirpated over the given time frame. For a population to be at high risk, there is a high likelihood of the threat occurring over the given time frame (greater than 90 percent) and the threat would have a high or severe impact.

Table 3: Risk matrix used to estimate overall risk to a population posed by a stressor by the likelihood of it occurring and the magnitude of impact.

		Magnitude			
		Low	**Medium**	**High**	**Extreme**
Likelihood	**Remote**	Low	Low	Low	Low
	Unlikely	Low	Medium	Medium	Medium
	Likely	Low	Medium	High	High
	Known	Low	Medium	High	High

Since being at high risk for any one of the threats implies the population is at risk for extirpation, if a population was assigned a score of high risk for one or more threats, we gave it an overall risk ranking of high. Similarly, if a population was assigned medium risk of extirpation due to one or more threats, we gave it an overall risk of medium. Thus, for a population to be at low risk of extirpation, it had to be at low risk across all three threats.

As part of the estimation of extirpation risk, the risk assessment defined timeframes to project the likelihood of a given threat occurring. We projected risk out to three time points. We first assessed risk of extirpation for each population over the next 10 years. This is meant to reflect the extirpation risk based on the current demographic and habitat conditions of each population and does not include any potential changes due to climate change. Since conditions are expected to change in the future, we also projected out to two future timepoints: mid-century (i.e., 2050) and end of century (i.e., 2099). These two future timepoints were selected as they correspond to available projections of environmental variables under climate change models. We projected the future viability of the Rio Grande chub under two climate scenarios. They are meant to represent the upper and lower bounds of plausible future impacts of threats and the species' response to them. They are not the only possible future outcomes: instead, they represent plausible high and low limits to the future progression of environmental conditions and their implications for Rio Grande chub viability. For the "Low Effects" scenario, we project future environmental suitability under Relative Concentration Pathway (RCP) 4.5, which reflects a peak in global carbon emissions by 2040. For the "High Effects" scenario, projections of environmental suitability are under RCP 8.5, which reflects a rise in carbon emissions through the end of the century.

To explicitly incorporate these scenarios in our assessment, we developed a quantitative habitat suitability model for the Rio Grande chub based on its current distribution and projected changes under the two climate change scenarios. With this model, we were able to project future changes in habitat suitability, which we then used to estimate future resiliency of extant populations. To incorporate these changes into our risk assessment, we adjusted the occupied stream length for each population based on the change in the probability of suitability. In other words, we assumed that the effects of changing suitable habitat would manifest in terms of occupied stream length, which would then integrate into our condition metrics. After recalculating resiliency scores based on projected changes in habitat, we then re-estimated the risk of extirpation using the threat assessment matrix. Given the increase in time, we did adjust likelihood scores, mainly for wildfire, in our assessment. Further discussion on methodology for assessing future extirpation risk can be found in the SSA Report (Service 2024, pp. 48–72).

POPULATION STATUS AND INITIAL RESILIENCY

After reviewing the rangewide species database, we identified 53 Rio Grande chub populations in the United States that combined occupy 844.0 kilometers (km) (524.4 miles (mi)) of stream length. Multiple populations are extant in all of the major drainage basins (i.e., GMUs) that are part of the species' historical range. Many of the resiliency scores are influenced by the presence of nonnative species: 70 percent of populations co-occur with nonnative trout. Twenty-six populations fell in the high category for abundance, population stability, and occupied stream length, but were downgraded to moderate overall condition due to co-occurrence with nonnative trout. Aside from nonnatives, occupied stream length influenced the resiliency scores: 12 populations were ranked as low, with another 11 as moderate. The majority of populations (77

percent) had stable or increasing population stability ranking, and all had either a high or moderate ranking for relative adult abundance. Overall, most populations (51 percent) are in moderate initial resiliency, indicating they are likely to persist, while 36 percent are in low initial resiliency. We found that only a small proportion of Rio Grande chub populations are in a high initial resiliency category (13 percent) (Table 4), indicating they do not co-occur with non-native trout, occupy a long stream segment, and have abundant, self-recruiting populations. All of the high resiliency populations were in the three Rio Grande GMUs: neither the Upper Canadian or Upper Pecos GMUs had any highly resilient populations. Most populations in the Upper Canadian GMU (75 percent) are in low resiliency. In contrast, most populations (67 percent) of those in the Upper Pecos had moderate resiliency. These initial resiliency scores influenced the magnitude of impact scores for the risk assessment. Further details on the resiliency scores for these populations can be found in the SSA Report (Service 2024, pp. 70–74).

Table 4: Final initial status of Rio Grande chub showing the number (N) of conservation populations and total occupied stream length in three overall resiliency condition categories by GMU after incorporating the presence of nonnative trout.

	High			**Moderate**			**Low**		
GMU	**N**	**km**	**mi**	**N**	**km**	**mi**	**N**	**km**	**mi**
Rio Grande – Elephant Butte	3	55.7	34.6	12	351	218.1	10	56	34.8
Rio Grande – Headwaters	1	7	4.4	7	182.1	113.2	3	29.1	18.1
Rio Grande – Mimbres	3	51.1	31.8	1	4.3	2.7	0	0	0.0
Upper Canadian	0	0	0.0	1	13	8.1	3	10.3	6.4
Upper Pecos	0	0	0.0	6	64.5	40.1	3	19.9	12.4
Total	**7**	**113.8**	**70.7**	**27**	**614.9**	**382.2**	**19**	**115.3**	**71.7**

RISK ASSESSMENT

After developing an extirpation risk score, we found that most populations (30 out of 53) were at a medium risk of extirpation in the next ten years. Of the remaining 23 populations, 18 were at high risk, and 5 were at low risk. This was primarily driven by nonnative species: 37 populations are invaded by nonnative trout, with 18 of those determined to be at high risk of extirpation. For the medium risk populations, 28 out of the 30 co-occur with nonnative trout. Thus, their resiliency is reduced by the presence of these nonnatives, but not to the point where severe population declines are expected. We expect that medium risk populations are likely to persist

over the next 10 years, mainly because they continue to maintain the characteristics of a resilient population (e.g., occupied stream length, adult abundance) despite exposure to nonnatives. Two populations are exposed to potential catastrophic dewatering and none were at high risk of extirpation due to wildfire over the next ten years. All GMUs, except the Upper Canadian, had at least one population in the low risk category.

Table 5: Number of populations of Rio Grande chub in each risk category of extirpation over the next 10 years.

GMU	Low risk	Medium risk	High risk
Rio Grande - Elephant Butte	1	15	9
Rio Grande - Headwaters	2	6	3
Rio Grande - Mimbres	1	3	0
Upper Canadian	0	1	3
Upper Pecos	1	5	3
Total	**5**	**30**	**18**

For projections out to mid and late-century, we first assessed whether changes in habitat suitability under climate change would affect resiliency scores. In general, habitat suitability is projected to change progressively through time and this change is greater under the High Effects scenario than the Low Effects scenario (Service 2024, pp. 74–82). While some populations have increased habitat suitability in one or more projections, the general trend is toward declining suitability, particularly in late century under High Effects. Incorporating this in future resiliency, 39 (74 percent) of the populations were projected to have no change in resiliency across all scenarios. One population was projected to experience an increase in future condition under some of the scenarios combinations due to increases in habitat suitability. Another 13 may experience reductions in condition under some scenarios due to declines in suitable habitat.

There was little projected change in risk scores to mid and late-century (Tables 6 and 7). Most populations (28 to 29) continue to be at a medium risk of extirpation. At least 3 to 4 populations were projected to be at low risk of extirpation across all scenarios and time steps. In the High Effects scenario by late century, 28 populations were projected to be at medium risk of extirpation, another 22 were projected to be at high risk. This pattern of increasing extirpation risk was similar across major drainage basins. Under all scenarios, risk due to dewatering was low for all but two populations, but over time an increasing proportion became at medium or high risk of extirpation due to wildfire. Even so, most populations are likely to persist over the timeframes projected, and 74 percent are not expected to experience a change in resiliency. More details on the results of our future scenario analysis can be found in the SSA Report (Service 2024, pp. 83–93).

Table 6: Number of Rio Grande chub populations in each risk category of extirpation under the Low Effects Scenario, compared to current risk. Categories reflect risk over the next 10 years at

each time step.

	Current Condition			Mid-Century			Late Century		
GMU	**Low risk**	**Medium risk**	**High risk**	**Low risk**	**Medium risk**	**High risk**	**Low risk**	**Medium risk**	**High risk**
Rio Grande - Elephant Butte	1	15	9	1	14	10	1	14	10
Rio Grande - Headwaters	2	6	3	2	5	4	2	5	4
Rio Grande - Mimbres	1	3	0	0	4	0	0	4	0
Upper Canadian	0	1	3	0	1	3	0	1	3
Upper Pecos	1	5	3	1	5	3	1	5	3
Total	**5**	**30**	**18**	**4**	**29**	**20**	**4**	**29**	**20**

Table 7: Number of Rio Grande chub populations in each risk category of extirpation under the High Effects Scenario, compared to current risk. Categories reflect risk over the next 10 years at each time step.

	Current Condition			Mid-Century			Late Century		
GMU	**Low risk**	**Medium risk**	**High risk**	**Low risk**	**Medium risk**	**High risk**	**Low risk**	**Medium risk**	**High risk**
Rio Grande - Elephant Butte	1	15	9	1	14	10	0	14	11
Rio Grande - Headwaters	2	6	3	2	5	4	2	6	3
Rio Grande - Mimbres	1	3	0	0	4	0	0	4	0
Upper Canadian	0	1	3	0	1	3	0	1	3
Upper Pecos	1	5	3	1	5	3	1	3	5
Total	**5**	**30**	**18**	**4**	**29**	**20**	**3**	**28**	**22**

Levels of risk were consistent across the range of the species: across drainages basins, most populations were at an overall medium risk of extirpation across time steps and scenarios (Service 2024, pp. 90–96), indicating they are likely to persist. The risk of extirpation posed by specific threats did vary by basin; for example, most of the populations at the greatest risk of

wildfire by mid and late-century were in the Rio Grande- Elephant Butte area (Service 2024, p. 90). However, these geographical differences in specific threats had little bearing on the overall risk of extirpation results when combined across all three threats. Projections of habitat suitability under climate change scenarios did not markedly differ between drainage basins (Service 2024, pp. 77–86).

The exception to this pattern is the Canadian River basin, which contains four populations of the Rio Grande chub. Across all time steps (10 years, mid-century, late-century) and scenarios, 3 of the 4 populations are considered at high risk of extirpation. The other is considered at moderate risk. The 3 high risk populations are all invaded by nonnative trout and have low resiliency scores, elevating their risk of extirpation.

In Mexico, all reports are that *G. modesta* is in a precarious situation, but there is little quantitative data available that could be used to assess the status of the species or its habitat. What information is available on *G. modesta* habitat states the habitat is degraded due to stream channelization and nonnative species are also present, including species of platyfish (genus *Xiphophorus*) (Lozano-Vilano et al. 2020, pp. 83–84). Lyons et al. (2020, p. entire) assessed 536 species of freshwater fishes native to Mexico using Red List Categories and Criteria. They found *G. modesta* met the Red List threshold for endangered, based on its restricted range and small population size. The population size is listed as between 500-2500 individuals and declining over time. Contreras-Balderas et al. (2003, p. 246), using criteria developed by the American Fisheries Society (Williams et al. 1989, p. entire), considered *G. modesta* to be endangered and noted that it only occurred in 1 of the 12 localities from which it was known. Therefore, we conclude this population is at a high risk of extirpation.

FINDING

Regulatory Framework

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species is an “endangered species” or a “threatened species.” The Act defines an endangered species as a species that is “in danger of extinction throughout all or a significant portion of its range,” and a threatened species as a species that is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The Act requires that we determine whether any species is an “endangered species” or a “threatened species” because of any one or a combination of the following factors:

(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.

These factors represent broad categories of natural or human-caused actions or conditions that could have an effect on a species' continued existence. In evaluating these actions and conditions, we look for those that may have a negative effect on individuals of the species, as well as other actions or conditions that may ameliorate any negative effects or may have positive effects.

The Act does not define the term "foreseeable future," which appears in the statutory definition of "threatened species." Our implementing regulations at 50 CFR 424.11(d), which is further described in the 2009 Memorandum Opinion on the foreseeable future from the Department of the Interior, Office of the Solicitor (M–37021, January 16, 2009; "M-Opinion," available online at *https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/M-37021.pdf*). The foreseeable future extends as far into the future as the U.S. Fish and Wildlife Service and National Marine Fisheries Service (hereafter, the Services) can make reasonably reliable predictions about the threats to the species and the species' responses to those threats. We need not identify the foreseeable future in terms of a specific period of time. We will describe the foreseeable future on a case-by-case basis, using the best available data and taking into account considerations such as the species' life-history characteristics, threat-projection timeframes, and environmental variability. In other words, the foreseeable future is the period of time over which we can make reasonably reliable predictions. "Reliable" does not mean "certain"; it means sufficient to provide a reasonable degree of confidence in the prediction, in light of the conservation purposes of the Act.

It is not always possible or necessary to define the foreseeable future as a particular number of years. Analysis of the foreseeable future uses the best scientific and commercial data available and should consider the timeframes applicable to the relevant threats and to the species' likely responses to those threats in view of its life-history characteristics. Data that are typically relevant to assessing the species' biological response include species-specific factors such as lifespan, reproductive rates or productivity, certain behaviors, and other demographic factors.

Status Throughout All of Its Range

Currently there are 53 populations of the Rio Grande chub in the United States, along with a single population of *G. modesta* in Mexico. Populations in the United States occupy around 844.0 kilometers of stream length and are distributed across multiple river basins. Although this represents a substantial reduction in the historical range, the species is no longer experiencing systemic population declines or extirpations. In fact, the occupied range has expanded in recent years due to reinductions and expansions of existing populations. The primary causes for the historical declines were the introductions of nonnative species and hydrological alterations, especially in the mainstem Rio Grande. Although nonnative species continue to co-occur with many Rio Grande chub populations, further declines have been avoided, mainly due to management actions. The populations that due remain are also not exposed to the types of

infrastructure (e.g., large dams, water diversion structures) that altered the hydrology of much of the historical range.

Currently, the primary threat to the species is nonnative aquatic species, particularly nonnative species of trout. Seventy percent of populations co-occur with nonnatives species that may impact Rio Grande chub populations. Rio Grande chub are also affected by wildfires, although for most populations the likelihood of wildfire impacts in the near-term is low. Despite the pervasiveness of nonnatives, 66 percent of populations currently have either high or moderate resiliency, meaning they have capacity to withstand stochastic events such as seasonal changes in water levels and temperatures. The predominance of medium risk populations (57 percent of the total) is mainly driven by co-occurrence with nonnative species, which elevates the risk of extirpation. However, those medium risk populations still retain the characteristics of resilient populations (e.g., sufficient occupied stream length, robust demographics) that have been able to persist despite the presence of nonnatives. In others words, even with the presence of nonnatives, for medium risk populations we project that they will continue to maintain resiliency and have low exposure to other threats that they are unlikely to be extirpated. For the remaining 34 percent, based on their initial resiliency and exposure to threats they are at a high risk of extirpation in the next 10 years. High and moderate resiliency populations are distributed across multiple river basins in the United States covering a wide geographic area across multiple GMUs and watersheds, providing redundancy and limiting the potential for a catastrophic event to result in rangewide extirpations.

Given the extensive range reduction the species has experienced, there has likely been an overall reduction in adaptive capacity. Populations of Rio Grande chub are also highly fragmented and isolated, which would reduce potential for dispersal and gene flow. There are also fewer populations at higher risk of extirpation in some areas comparable to others, most notably the Canadian River GMU. However, multiple populations exist across diverse watersheds and ecological gradients across much of its historical range. The species continues to demonstrate its adaptability, as evidenced by rebounds following variation in environmental conditions. Some populations thrive in novel and/or highly manipulated environments. Unique genetic lineages have also been preserved via hatchery broodstocks, which can be used to augment or restore populations. Despite the isolated nature of populations, most are demographically stable. This is due to sufficient resources, including habitat diversity and population abundance, being available that buffer against the effects of fragmentation. For example, all populations scored either high or moderate for relative adult abundance, and most (77 percent) had stable or increasing abundance, indicating recruitment. Even with the levels of fragmentation, 77 percent of populations occupy stream segments long enough to fall within the high or moderate category, which supports resiliency and allows for the population to rebound after stochastic events. Importantly, some of this fragmentation is intentional: barriers have been constructed to reduce the likelihood of nonnative fish invasion. Even with the extensive reductions in range and fragmentation it has experienced, the Rio Grande chub retains sufficient adaptive capacity to support the species' viability.

After evaluating threats to the species and assessing the cumulative effect of the threats under the section 4(a)(1) factors, we have determined that the Rio Grande chub is currently not at risk of rangewide extirpation due to nonnative species (Factor C), dewatering (Factor A), wildfire (Factor A), and the effects of climate change (Factor E). Thus, after assessing the best available information, we conclude that the Rio Grande chub is not in danger of extinction throughout all of its range.

Therefore, we proceed with determining whether the Rio Grande chub is likely to become endangered within the foreseeable future throughout all of its range. As discussed above and in the SSA Report, the Rio Grande chub is most at risk in the future from the effects of nonnative species, wildfire, and dewatering. Climate change has the potential to affect habitat suitability among existing populations. The SSA Report evaluated the implications of these threats through a quantitative predictive habitat model and a risk assessment.

Based on data we were able to obtain regarding future environmental variables, we were able to project future habitat suitability to the end of the century. Accordingly, our risk assessment also estimated risk of extirpation over the same period based on information available regarding future likelihood and magnitude of the primary threats. In general, our habitat model projects a rangewide decrease in habitat suitability over time. However, most of these reductions were minor, and only 13 populations were projected to experience a decline in resiliency over time. Five of those declined from high to moderate resiliency; the other eight declined from moderate to low, depending on the scenario. For most populations (85 percent), the overall risk of extirpation was unchanged over time. Although we project that at best only 3 to 4 populations (6 to 9 percent) will be at low risk of extirpation by the end of the century, most will be at medium risk (53 to 57 percent) and are unlikely to face extirpation. The largest change in risk over time is due to the increasing likelihood of wildfire, but most populations are still not projected to be at high risk of extirpation due to wildfire. This indicates that even with projections of climate change and increasing likelihood of threats, overall resiliency and risk of extirpation are not projected to change for most populations. That means populations are expected to retain the resources, mainly habitat quantity, necessary to remain resilient. It also means that populations are either in areas not at high risk of a catastrophic event (e.g., wildfire, dewatering) or are protected in limit the potential for future threats (e.g., barriers).

Because the risk of extirpation changes little over the remainder of the century, in the future we project that populations will continue to be distributed across multiple river basins. This wide geographic dispersion will provide redundancy, limiting the risks posed by catastrophic events. Given that populations are isolated, there may be an erosion of genetic diversity over time due to a lack of gene flow. This may reduce the potential for populations to adapt to changing environmental conditions. However, these populations will continue to exist across multiple drainage basins and ecological gradients, preserving standing adaptive capacity. Continuation of broodstock development will provide further safeguards for the species' genetic diversity. The

habitat modeling also indicates the Rio Grande chub's adaptable nature. For most populations, habitat suitability within existing occupied sites is not projected to decline substantially. This is in part due to the species' inherent adaptability, for it can thrive under a variety of conditions. In fact, for some populations, changes in environmental conditions under climate change could improve habitat suitability. Thus, we project that the Rio Grande chub will continue to have the ability to adapt to a changing world over this century.

Finally, conservation efforts, particularly over the past decade, have done much to ameliorate threats and improve the resiliency of existing populations. The installation of barrier, control of nonnatives, and enhancement of habitat have increased the resiliency of existing populations. Restoration work continues to add new populations and expand the species range. These conservation efforts will continue, evidenced by track record of the signatories of the conservation agreement. For existing populations, this would result in maintenance and addition of barriers to limit invasive by nonnative fish, as well as habitat improvements. Salvage operations following extreme events (e.g., wildfire, dewatering) provide an opportunity to restore populations that would otherwise be extirpated. Populations will continue to be restored in areas with suitable habitat. Nonnative fish removal will limit future invasion and even remove nonnative from areas where they co-occur with Rio Grande chub. Therefore, active conservation efforts currently are and will continue to reduce the impact of threats and improve the prospects for populations and the species as a whole.

After evaluating future threats to the species and assessing the cumulative effect of the threats under the section 4(a)(1) factors, we found that the Rio Grande chub is not projected to experience an increased risk of extirpation due to nonnative species (Factor C), dewatering (Factor A), wildfire (Factor A), or climate change (Factor E). Thus, after assessing the best available information, we conclude that the Rio Grande chub is not likely to become endangered within the foreseeable future throughout all of its range.

Status Throughout a Significant Portion of Its Range

Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range. Having determined that the Rio Grande chub is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we now consider whether it may be in danger of extinction or likely to become so in the foreseeable future in a significant portion of its range—that is, whether there is any portion of the species' range for which it is true that both (1) the portion is significant; and (2) the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. Depending on the case, it might be more efficient for us to address the "significance" question or the "status" question first. We can choose to address either question first. Regardless of which question we address first, if we reach a negative answer with respect to the first question that we address, we do not need to evaluate the other question for that portion of the species' range.

In undertaking this analysis for the Rio Grande chub, we chose to address the status question first. We began by identifying portions of the range where the biological status of the species may be different from its biological status elsewhere in its range. The range of a species can theoretically be divided into portions in an infinite number of ways. For this purpose, we considered information pertaining to the geographic distribution of (a) individuals of the species, (b) the threats that the species faces, and (c) the resiliency condition of populations to inform our delineation of portions. We determined that considering divisions by major hydrological drainage basins, meaning GMUs, was the appropriate unit to delineate portions.

As with the rangewide determination, we used our risk assessment as the basis to determine extinction risk and differences in the impacts of our various threats. Levels of risk were generally consistent across drainage basins: overall risk scores of high were not concentrated in any one drainage basin, indicating a lack of concentration of threats. Although there was some spatial variation in the risk posed by specific threats, such as wildfire, this variation did not impacts on the overall risk estimates at the GMU-level. Changes in habitat suitability due to climate change were also not more extreme in most of the major basins.

The exception to this pattern is the Canadian River basin, where three of the four populations are at high risk of extirpation, and the sole population in Mexico. This elevated risk is due to invasion by nonnative trout and overall low resiliency of those populations. Thus, populations in the Canadian River basin may have a different status than the remainder of the range. Therefore, we proceeded to determine if the Canadian River basin and Mexico are significant. These populations composed a very small portion of the species' range. They are 4 out of 53 populations in the United States and occupy 23.3 km (14.5 mi) of stream length, which is 3 percent of the occupied range (Service 2024, p. 72). Because this is such a small portion of the species' range, these populations would not constitute a significant portion of the species range.

In conclusion, we found no portion of the Rio Grande chub's range where the biological condition of the species differs such that the status of the species in that portion differs from its status in any other portion of the species' range. The exception would be the Canadian River basin and the populations in Mexico, but these portions are not significant. Therefore, we find that the species is not in danger of extinction now or likely to become so in the foreseeable future in any significant portion of its range. This does not conflict with the courts' holdings in *Desert Survivors v. Department of the Interior*, 321 F. Supp. 3d 1011, 1070-74 (N.D. Cal. 2018), and *Center for Biological Diversity v. Jewell*, 248 F. Supp. 3d 946, 959 (D. Ariz. 2017) because, in reaching this conclusion, we did not apply the aspects of the Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species" and "Threatened Species" (79 FR 37578; July 1, 2014), including the definition of "significant" that those court decisions held to be invalid.

Determination of Status

Our review of the best available scientific and commercial data indicates that the Rio Grande chub does not meet the definition of an endangered species or a threatened species in accordance with sections 3(6) and 3(20) of the Act. Therefore, we find that listing the Rio Grande chub is not warranted at this time.

COORDINATION WITH STATES

The range of the Rio Grande chub includes the states of Colorado, New Mexico, and Texas. Throughout the development of the SSA, we coordinated with these states to solicit their knowledge and information on the species. At the beginning of the SSA development process, we sent a letter requesting relevant information on the species to Colorado Parks and Wildlife, the New Mexico Department of Game and Fish, and the Texas Parks and Wildlife Department. Species experts from New Mexico and Colorado participated as technical experts in the SSA. Experts from all three agencies provided technical review of the draft SSA Report.

Colorado Parks and Wildlife, the New Mexico Department of Game and Fish, and the Texas Parks and Wildlife Department are signatories of the Conservation Agreement for the Rio Grande Chub and Rio Grande Sucker. These agencies have been active in promoting the conservation of the species through monitoring, data compilation and management, restoration of populations, habitat restoration, management of nonnative species, salvage operations, and public outreach.

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