BEFORE THE SECRETARY OF THE INTERIOR

Photo credit to J. Rorabaugh/U.S. Fish and Wildlife Service (Retired). Taken from USFWS 2022a, p. 1.

PETITION TO REVISE THE CRITICAL HABITAT DESIGNATION FOR SONORA CHUB (*GILA DITAENIA*) UNDER THE ENDANGERED SPECIES ACT

CENTER FOR BIOLOGICAL DIVERSITY

March 14, 2023

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NOTICE OF PETITION

The Honorable Deb Haaland
U.S. Department of the Interior
1849 C Street NW
Washington, D.C. 20240
doiexecsec@ios.doi.gov

Martha Williams, Director
U.S. Fish and Wildlife Service
1849 C Street NW
Washington, D.C. 20240
Martha_Williams@fws.gov

Amy Lueders, Regional Director
U.S. Fish and Wildlife Service
500 Gold Ave. SW
Albuquerque, NM 87102
RDLueders@fws.gov

Dear Secretary Haaland,

Pursuant to Section 4(b)(3)(D) of the Endangered Species Act, 16 U.S.C. §1533(b)(3)(D); Section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553(e); and 50 C.F.R. Part 424.14, the Center for Biological Diversity ("Center") and Krista Kemppinen hereby petition the United States Fish and Wildlife Service ("Service") to revise its critical habitat designation for the Sonora chub (*Gila ditaenia*).

This request is based upon the enclosed petition and evidence referenced therein. As the petition shows, critical habitat for the Sonora chub must be revised to include California Gulch as this revision is essential for the conservation of the species.

Should the Service determine that the proposed area to be added, in its entirety does not meet the criteria for such designation, we, in the alternative, request that the Service analyze whether a subset of this area should be designated as critical habitat.

We look forward to your positive and prompt 90-day and 12-month findings in response to this petition. Thank you for your consideration.

Dr. Krista Kemppinen
Senior Scientist
Center for Biological Diversity
PO Box 710
Tucson, AZ 85702
kkemppinen@biologicaldiversity.org

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I. EXECUTIVE SUMMARY

The Sonora chub is a small minnow endemic to southern Arizona and Sonora, Mexico. It was listed under the Endangered Species Act in 1986 due to threats from possible introduction of non-native species into its habitat and potential mining activities, combined with the species' very small range and intermittent stream habitat in the United States. Critical habitat was designated concurrently with listing to include the entire range of the species in the U.S. as it was known at the time. However, a second population was later discovered in California Gulch, outside of the current critical habitat designation. This petition seeks to expand critical habitat to this area. California Gulch has habitat features that are essential to the conservation of the species and that are subject to multiple threats such as livestock grazing, border activities and mining. A critical habitat designation is required to ensure that consultations analyze the impacts of human actions to both the species and the proposed critical habitat as the "jeopardy" and "destruction or adverse modification" standards are not interchangeable. There are also many benefits to designating critical habitat that go beyond those arising from the consultation process. Protecting California Gulch is additionally necessary to fulfill the Sonora chub recovery plan objective of maintaining populations in all extant locations. Finally, it is essential to the survival and recovery of the Sonora chub because of its precarious status and because it would increase the species' redundancy, resiliency and representation, and therefore its viability. Despite being listed for decades, the Sonora chub's ability to sustain long-term populations is highly uncertain due to its extremely limited range in the U.S. coupled with a growing number of threats and inadequate habitat protections.

II. INTRODUCTION

The Sonora chub is a small minnow endemic to streams in southern Arizona and northern Sonora, Mexico. It was listed in 1986 under the Endangered Species Act (ESA) due to being threatened by the possible introduction of exotic fishes and their parasites into its habitat, and by potential mining activities. It was considered to be particularly vulnerable to these threats due to its very limited range and intermittent stream habitat in the United States (USFWS 1986, p. 16042). Since then, the threats to the Sonora chub have grown to include climate change, fire and border activities. The species is also threatened by water development and grazing and continues to remain in a highly precarious state.

Critical habitat was designated concurrently with listing of the Sonora chub to include the entire U.S. portion of the species' range as it was known at the time (USFWS 1986, p. 16044). However, in 1995, a new population of Sonora chub was discovered in California Gulch, outside of the current critical habitat designation. According to USFWS, "the limited distribution of Sonora chub in the U.S. places inordinate importance on the quality of habitat in Sycamore

Creek *and California Gulch*" (USFWS 2015, p. 49, emphasis added). Yet, critical habitat was never revised to include this area because "the presence of Sonora chub there ensures that consultations for actions within the area are completed" (USFWS 2013, p. 5).

As will be shown in this petition, expanding critical habitat to include California Gulch is necessary to protect this area to the fullest extent of the ESA and to realize other indirect benefits. Protecting the California Gulch population is also necessary to achieve the species' recovery plan goals, and essential to the survival and recovery of the species.

III. NATURAL HISTORY

A. Description

The Sonora chub is a stream-dwelling minnow that can achieve lengths of up to 20 cm. In the United States, it usually does not exceed 12.5 cm, although there have been specimens of up to 15 cm. The chub has 63 to 75 scales in the lateral line, with scales bearing prominent radii in all fields. Its mouth is inferior and nearly horizontal. The dorsal, anal and pelvic fins usually have eight rays, although the dorsal fin can have nine, and the anal and pelvic fins seven. The body of the Sonora chub is moderately chubby and dark in color, with two prominent, black, lateral bands above the lateral line and a dark, oval basicaudal spot. Breeding individuals are brilliant in color. For example, the axils of the pectoral and pelvic fins and the base of the anal fin are brilliant Chinese red (USFWS 1992a, p. 6).

B. Biology

Spawning was originally thought to occur in early spring, based on collection dates of young-of-the-year (Minckley 1973 as cited in USWS 2011, p. 241). However, larval and juvenile Sonora chub were later found in Sycamore Creek and a Rio Altar tributary in November, suggesting breeding was not limited by season. Breeding adults (based on their coloration) were also taken during these periods (Hendrickson and Juarez-Romero 1990 as cited in USFWS 2011, p. 241). In Sycamore Creek, adults with breeding colors were observed from April through September in 1990 and 1991. Larvae and juveniles measuring 15 to 18 mm were observed in April, May and September, suggesting that spawning occurred after the spring and summer rains (USFWS 2011, p. 241 and Carpenter 1992 cited therein). Young have also been noted after heavy flooding, suggesting that post-flooding spawning is a survival mechanism evolved by this species (Bell 1984 as cited in USFWS 2011, p. 241). During spawning, it appears that Sonora chub broadcast their eggs onto fine gravel substrates in slow-moving water, where the eggs subsequently

develop and hatch. No nests are built and no parental care is given. It is likely that larvae use shallow habitats at pool margins where they consume microscopic organisms and algae. Adult chub can exploit shallow to deep pools, and runs and riffles as available (USFWS 2011, p. 241-242).

Based on an examination of the stomachs of a few individuals taken from Sycamore Creek, food items consisted of aquatic and terrestrial insects, and algae, in decreasing order of volume. Like other chubs, the Sonora chub probably feeds opportunistically, taking advantage of seasonally available resources (USFWS 1992a, p. 10-11).

C. Habitat

In Sycamore Creek, Sonora chub occur in the largest, deepest, most permanent pools (Carpenter 1992 as cited in USFWS 2017a, p. 108). Based on a habitat use analysis, Sonora chub prefer deep pools and some amount of floating cover (USFWS 1992 as cited in USFWS 2017a, p. 108). In Mexico, they were concentrated in deeper areas and under-cover, rather than randomly distributed. Preferred cover included fallen logs, areas of dense aquatic vegetation, and undercut root-masses, and these were used if associated with intermediate to low current velocity (USFWS 2017a, p. 108 and Miller 1945 cited therein).

As described in USFWS 2017a, although the Sonora chub's distribution is regularly limited to pools during arid periods, it prefers riverine habitats. In Mexico, Sonora chub in slow-moving waters were commonly found in pools less than 2 feet deep, adjacent to or near areas with swift current, over sand and gravel substrates. It was less commonly found in reaches with predominantly low velocity pools over organic sediments (Hendrickson and Juarez-Romero 1990 as cited in USFWS 2017a, p. 108). Sonora chub are adept at exploiting small, marginal habitats and are able to survive under the severe environmental and hydrologic conditions found in Sycamore Canyon and California Gulch. They can also maneuver upstream past obstructions such as small waterfalls to colonize newly-wetted habitats (USFWS 2017a, p. 108 and Carpenter and Maughan 1993 cited therein).

Sonora chub's ability to survive in Sycamore Canyon and California Gulch is due to their ability to respond to wet and dry cycles by expanding into riffles, runs, and pools during wet periods, and retreating back to deep pools during dry periods. A substantial number of individuals die upon becoming trapped in habitats that do not sustain water during arid periods (USFWS 2011, p. 243 and Carpenter and Maughan 1993 cited therein). Recolonization depends on those individuals that survive the dry period. As its habitat expands, the number of Sonora chub occupying newly-wetted habitats can explode in just a few weeks or months. The species' ability to expand its population by several orders of magnitude within just a few months is likely an adaptation to the harsh climate and intermittent nature of its habitat (USFWS 2011, p. 243 and Bell 1984 cited therein).

IV. RANGE AND STATUS

1. Distribution

Sonora chub are found in Sycamore Canyon and California Gulch in the U.S. and the Rio de Concepción drainage in Mexico (USFWS 2013, p. 8). The majority of the species' range is in Mexico (USFWS 2019, p. 8), where the species faces threats from water development (USFWS 1992a, p. 21), non-native species (USFWS 2019, p. 2), Asian tapeworm (Ibid., p. 3) and climate change, but receives comparatively little administrative protection (USFWS 2022a, p. 6). This places inordinate importance on the status of the U.S. populations.

Sonora chub appear to be distributed as metapopulations, or "populations of populations" but the type of metapopulation structure (e.g. Levins population model) (University of Idaho 2010, p. 2-3) is unclear. The main U.S. population, or metapopulation, of Sonora chub occurs in Sycamore Canyon (USFWS 2013, p. 4), located within the Coronado National Forest (CNF). The final listing rule for the Sonora chub (USFWS 1986) described the species as being found in Sycamore Creek proper, which flows downstream 3.7 miles and during years of heavy rainfall, reaches the international border. The fish may then extend its range to the border, if not beyond. Sonora chub were also described as being found in Yank's Spring, located about 0.5 miles above the Creek, the lower 1.25 stream miles of Penasco Creek, a tributary to Sycamore Creek, and the lower 0.25 stream miles of an unnamed stream entering Sycamore Canyon from an unnamed Canyon in the west (USFWS 1986, p. 16042). Within the Sycamore Canyon watershed, Sonora chub have additionally been detected in another unnamed canyon and Atascosa canyon (USFWS 2013, p. 13), as well Tinaja Spring Canyon and Little Tinaja Spring Canyon (Stefferud and Stefferud 2007, p. 44). More recently, Sonora chub were observed in a spring run feeding into Sycamore Canyon near the Mexican border (USFWS 2022a, p. 3).

The other U.S. population of Sonora chub occurs in California Gulch, also within CNF (USFWS 2013, p. 13) and its tributary streams (Ibid., p. 27)[1]. The exact nature of this population's relationship to the Sycamore Canyon population is unclear due to the two populations being described as two separate (or likely separate) metapopulations (USFWS 2011, p. 245; USFWS 2013, p. 13, 16, 18; USFWS 2022a, p. 5) as well as, as populations that are likely part of the same metapopulation (USFWS 2013, p. 27; USFWS 2017a, p. 109). Sonora chub have been described as being reliably present in suitable habitat from the "tinaja", a deep perennial pool situated just below a small dam, downstream to the international border (USFWS 2017a, p. 109). Data collected on California Gulch fish, including weekly fish surveys during July-August 2000, have documented significant expansion and contraction of the Sonora chub's distribution within California Gulch (Stefferud 2000 as cited in Stefferud and Stefferud 2007, p. 18). This study found apparently long-term populations in the tinaja and border exclosure. According to this

[1] the entire U.S. range of the Sonora chub is within CNF, except for small inholdings (USFWS 2011, p. 243).

information, Sonora chub occupy habitat in the U.S. on a permanent basis and move out from the two core areas, during periods of flow, to occupy all of the intervening 2.2 miles. However, both upstream and downstream migration are also argued to likely be involved in this population (Stefferud and Stefferud 2007, p. 18)[2].

In practice, the Sonora chub population in California Gulch has likely fluctuated over both time and space, perhaps at times persisting in low enough numbers to avoid detection. The CNF for example reported Sonora chub to be absent from California Gulch in 2000 (the same year Stefferud (2000) conducted surveys and found apparently long-term populations), with the Service using CNF presence/absence data from 1999 to 2012 to confirm recolonization of California Gulch (USFWS 2013, p. 10, 11). The source of the colonizers is not clearly stated, but points to Sycamore Canyon (USFWS 2013, p. 10). The Service has also reported the apparent variation in the upstream limits of the species' occurrence in California Gulch, based on the presence of non-native fish in the tinaja (Ibid., p. 11). Recolonization of California Gulch is further reported to have occurred following drought conditions (Ibid., p. 27), as well as specifically from permanent pools in Mexico (USFWS 2017a, p. 110). In 2011, recolonization was said to be occurring from Mexico "under present conditions and as runoff allows" (USFWS 2011, p. 246), although the area being recolonized (California Gulch and/or Sycamore Canyon) was not specified. It was additionally implied that US fish were recruiting to populations in Mexico (Ibid.). In June 2022, no Sonora chub were found by AZGFD in sampled pools in California Gulch (USFWS 2022a, p. 4). Finding no fish, AZGFD hypothesized that the stream had only become wetted by runoff from recent rains and the United States reach was likely ephemeral (USFWS 2022a, p. 5). However, it is unclear how much of California Gulch was surveyed[3].

In addition to the two wild metapopulations, there is a captive Sonora chub population of 400 to 500 individuals in the US, at the Arizona-Sonora Desert Museum. No captive or refugia populations are known to exist in Mexico (UFWS 2022a, p. 5).

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[2] It is not entirely clear if upstream migration refers to migration from Mexico or migration north of the tinaja. The latter may be difficult since USFS 2019 has noted that "Sonora chub currently exist only in the lower 3.2 km (2.0 mi) of California Gulch. The species is restricted to further movement upstream to suitable and potential habitat by a concrete dam. The overall habitat currently available is 6.4 km (4 mi) including the habitat, which is occupied below the dam." (USFS 2019, p. 19). It is assumed that the concrete dam refers to the dam just above the tinaja. The distances are also assumed to represent stream miles, meaning that the Sonora chub likely occupies around 2 miles of stream below the tinaja dam.

[3] "No Sonora chub were detected in sampling of California Gulch in June of 2022, although the pools sampled by AGFD may have only recently become inundated by rains (Elizabeth Grube pers. comm. 2022b). International border security issues were noted by AGFD as further complicating efforts to monitor populations of Sonora chub." (USFWS 2022a, p. 4)

2. Population status

In its first (2013) 5-year review of the Sonora chub's status, the Service estimated that the Sonora chub's global distribution was relatively similar to its historical range and that populations were relatively stable in the U.S., while the status of the chub in Mexico was described as unknown (USFWS 2013, p. 8, 11, 14). In the second (2022) 5-year review, the status of the Sonora chub population and its critical habitat were estimated to remain largely as described in the 2013 5-year review (USFWS 2022a, p. 3). These assessments, however, are highly uncertain due to a lack of information on population sizes and trends caused by the absence of rigorous, consistent and frequent surveys (USFWS 2013, p. 10-11; USFWS 2019, p. 8-9; USFWS 2022a, p. 3-4). In Mexico, the only recent (post-2013) detection data has included a collection in 2015 from the Rio Cocóspera at Rancho El Aribabi in Sonora. Sonora chub were also detected in the Rio Cocóspera in 2017 and 2022, as well as Rio Bambuto in 2022 (USFWS 2022a, p. 4). In the U.S., CNF monitoring reports from 2014 to 2021 included activities to conserve Sonora chub but did not report on its presence, other than stating a lack of dead or dying individuals (USFWS 2022a, p. 3). A 2019 biological assessment by the CNF gives the "overall estimated current chub habitat" as 16.1 km (10 mi) in Sycamore Creek and California Gulch[4], and the available and occupied habitat in the Gulch as 6.4 km (4 mi) and 3.2 km (2 mi) respectively (USFS 2019, p. 19).

Recent monitoring reports from AZGFD and USFWS staff are also insufficient and seemingly consistent with a probable reduction in the amount of wetted habitat as a result of ongoing drought conditions (USFWS 2013, p. 14): In Sycamore Canyon, Sonora chub were found as numerous individuals in a large pool in May 2014, found at another site in October 2014, and detected in 3 pools at a protected spring run feeding into the Canyon in 2017. However, although Sonora chub were observed in Sycamore Canyon on site visits in 2019 and 2022, fish were absent from dry reaches of Penasco Canyon and an unnamed tributary (USFWS 2022a, p. 3-4). Increasing aridity has also affected Hank and Yank's Tank, a structure impounding the discharge from Yank's Spring in Sycamore Canyon. Hank and Yank's Tank was previously known to be consistently occupied by the Sonora chub. However, the site was found dry in May 2017 and no chub were present in the tank in June 2022 (USFWS 2022a, p. 5). California Gulch is said to have been affected by aridity (USFWS 2022a, p. 5). The border exclosure in California Gulch was also found to be dry during two Center visits in 2020 and 2021. However, streams that flow greater than 90% of the time are still considered perennial in some definitions due to the fact that even perennial streams can cease flowing under severe drought conditions (Stefferud and Stefferud 2007, p. 5). Based on the Arizona percentage area in an exceptional drought category (D4) from ~ early January 2000 to ~mid-February 2023, drought in Arizona was by far the most

[4] Possibly under conditions of heavy runoff as in 2011, the USFWS estimated that a maximum of 10 stream miles may be occupied by the Sonora chub in the U.S., under conditions of heavy runoff (USFWS 2011, p. 245).

severe from ~end of November 2020 to ~mid-July 2021 (National Drought Mitigation Center 2023).

In addition to drought and climate change, Sonora chub are threatened by water development, livestock grazing, mining, border activities, recreation, fire, non-native species and an invasive parasite. Sycamore drainage has been highly modified by human activities (USFWS 2015, p. 49-50), and channel degradation, siltation, and water pollution due to primarily livestock grazing, roads, and mining have likely affected the habitat of Sonora chub (Ibid., p. 50). In California Gulch, Sonora chub habitat is likely being degraded by a combination of threats including livestock grazing, non-native species, border activity and infrastructure, and potentially mining. These and other threats are described in more detail below.

V. THREATS

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

1. *Water Development*

Continued demand for water for human consumption is one of the main threats to the Sonora chub (USFWS 2019, p. 2). Water development together with climate change threaten to alter the hydrologic conditions sustaining the streams in Sonora chub habitat, potentially reducing the resiliency of the species and its ability to survive stochastic events (USFWS 2019, p. 6-7). Increased water demand and withdrawal may occur as a result of increased grazing and mining operations in upstream watersheds (USFWS 1992a, p. 16), and border activities (USFWS 2013, p. 21). In addition, there is stream diversion, bank stabilization, channelization and irrigation agriculture happening in the watershed, although the latter activity is declining (USFWS 2011, p. 24). No instream flow water rights have so far been acquired by the Service and any such rights would be junior to consumptive surface water rights already in place. Moreover, surface water rights do not protect against groundwater pumping effects (USFWS 2019, p. 6).

In Mexico, Sonora chub in the upper Rio de la Concepcion basin have been locally affected by habitat modifications, primarily small reservoirs and diversions. In addition, a large impoundment in the Rio Altar desiccated a long reach of stream, destroying chub habitat (USFWS 1992a, p. 15-16). Long reaches of the lower Rio de la Concepcion that may have supported Sonora chub have also been dried up by impoundment, diversion and pumping (Ibid., p. 17). Modification of watercourses and dewatering of streams is a continuing threat (Ibid., p. 21).

2. *Mining*

Claim sites exist where uranium exploration occurred along the eastern slopes of Sycamore Canyon. Uranium was found at part of the sites, and the claims are being maintained (USFWS 1992 as cited in USFWS 2013, p. 15). The Sycamore Creek drainage has valuable minerals, and the development of mining activity may have severe adverse effects on Sonora chub through such activities as increased water demand and withdrawal, habitat disturbance, siltation, and pollution (USFWS 1986, p. 16044). Inactive mines also exist within the watershed of California Gulch, and if allowed to operate, these could impact Sonora chub habitat (USFWS 2013, p. 15). Mining wastes and/or drilling compounds have, furthermore, been known to enter California Gulch from a series of drilling pads immediately across the international boundary in Sonora. These compounds are sufficiently fine-grained to occlude the gills of Sonora chub and depending on their chemical composition, may be acutely and/or chronically toxic to the species. Discharges may also fill pools, preventing Sonora chub from seeking refuge from intermittently-dry stream reaches, and/or embed sediments enough to appreciably reduce the species' aquatic macro-invertebrate food base (Ibid., p. 16).

3. *Livestock grazing*

According to the Service's 2013 Sonora chub 5-year status review, livestock grazing is having adverse impacts that may set back the recovery of the Sonora chub (USFWS 2013, p. 16), with the Service further noting that (Ibid.):

The degradation, siltation, and water pollution caused primarily by livestock grazing within the riparian corridors remain threats in areas where grazing is not properly managed (USFWS 2012a). The Sonora chub prefers pools of clear water created by cliffs, boulders, and other cover in intermittent streams. It is difficult for cattle to reach areas like these, but upstream grazing can affect downstream habitat conditions. Grazing activities associated with the CNF's Rangeland Management Program may result in adverse effects to the Sonora chub's critical habitat. Livestock grazing activities can contribute to changes in surface runoff quantity and intensity, sediment transport, and water holding capabilities of the watershed (USFWS 2002, USFWS 2012a). This occurs especially where cattle tend to congregate, often near water sources (USFWS 2012a).

Cattle have in the past regularly gained access to Sycamore Canyon through an un-maintained section of fence along the international border, degrading riparian vegetation in the lower 4.0 km (2.5 mi) of the stream. The fence was subsequently repaired, and at the time of writing of the 5-year review, cattle impacts had not been detected in CNF monitoring data within the past 5 years. However, it was noted that upstream effects from grazing and cattle trespassing into restricted areas could still occur (USFWS 2013, p. 16).

In the Service's 2022 Sonora chub status review, grazing was said to remain as described in the 2013 status review. Cattle were found by AZGFD in an exclosure at Casita Spring in 2022, albeit

in the context of restoring the spring and preventing additional cattle entry. The Service also noted the lack of livestock grazing effects on the Sonora chub's status in CNF monitoring data (USFWS 2022a, p. 4). However, as described in Section IV, there is no rigorous monitoring of the Sonora chub and it is therefore likely that any population health impacts would go at least partially undetected.

In their February 2019 Biological Assessment for Coronado National Forest Livestock Grazing Program (USFS 2019), The Forest Service determined that "indirect effects to Sonora chub and PCEs of critical habitat occurring within the action area which result from upland livestock grazing are […] insignificant and discountable as measured through quantitative or qualitative measures such as watershed health and condition, use levels, or sedimentation" (USFS 2019, p. 22). However, "Direct effects to Sonora chub and PCEs of critical habitat may occur because livestock are not completely excluded from occupied and designated critical habitat in some allotments within the action area and, therefore, may trample and ingest Sonora chub and their eggs, impair water quality, and deteriorate habitat." (Ibid.).

In addition to the above effects, livestock grazing can alter stream cover that the Sonora chub may rely on for shelter, and increase sedimentation and stream temperatures by creating shallower and wider streams through increased erosion of banks (Batchelor et al. 2015, p. 930-931). Water demand and withdrawal for grazing operations is another potential threat (USFWS 1992a, p. 16), as is the development and maintenance of stockponds. The latter may support nonnative fish populations or provide habitat into which nonnative fishes may be introduced for sportfishing or other purposes. The nonnative fish may subsequently be introduced into habitat occupied by the Sonora chub or traverse drainages between stockponds and the creek during storm events. The construction or reconstruction of roads to stockponds would also facilitate public access, increasing the likelihood that nonnative fish may be introduced or moved among tanks (USFS 2019, p. 21).

The Center for Biological Diversity recently recorded impacts to Sonora chub habitat in California Gulch and Sycamore Canyon from cattle grazing. We first documented cattle impacts in the Sycamore Canyon exclosure (Pajarito Wilderness/ Goodding Research Natural Area) in our 2020 report showcasing grazing damages to designated Chiricahua leopard frog critical habitat (Center for Biological Diversity, 2020, p. 99-103). We provided Center (2020) to the Forest Service and USFWS on January 6, 2021. We documented cattle impacts within both California Gulch Sonora chub exclosures in our July 30, 2021 Sonora chub critical habitat revision petition (Center for Biological Diversity 2021, p. 13-31). In the Center's February 28, 2022 Notice of Intent to the Coronado National Forest and USFWS for ESA violations, we again raised the issue of cattle damages to Sonora chub habitat, and noted continued cattle presence and significant impacts in the Sycamore Canyon exclosure (Center for Biological Diversity 2022, p. 67, 75, 92-96, 104-108). Following our 2022 Notice, we have continued to document cattle presence inside protected Sonora chub exclosures. Figure 1 shows cattle impacts within the

Sonora chub border exclosure documented on December 5, 2022, while figure 2 shows cattle impacts in designated Sonora chub critical habitat in the Sycamore Canyon exclosure. Our continued documentation of grazing damages within Sonora chub exclosures and existing critical habitat indicate that grazing is a chronic problem in remaining Sonora chub habitat.

Figure 1. Cattle impacts within the Sonora chub border exclosure. 31.391948, -111.249215. December 5, 2022.

Figure 2. Cattle impacts in designated Sonora chub critical habitat in the Upper Sycamore Exclosure/ Pajarito Wilderness/ Goodding Research Natural Area. 31.424152, -111.195166. December 5, 2022.

4. *Border activities*

There has been a massive increase in cross-border activity and enforcement actions by the Department of Homeland Security (DHS) since the Sonora chub was listed in 1986. The increased traffic has increased both on- and off-highway vehicle traffic throughout the Sycamore Canyon and California Gulch watersheds. Repeated federal actions combined with the cumulative effects of the illegal activity itself are likely causing impacts to Sonora chub that include bank trampling, increased sedimentation, and other impacts caused by cross-country foot and vehicle travel (USFWS 2013, p. 21).

Other DHS cross-border activities along the international border that could impact the Sonora chub include, but may not be limited to, the following: human traffic and the associated increase in fire risk, deposition of trash, new trails from human traffic, soil compaction and erosion, water depletion and contamination, introduction and spread of disease, and interference with surveying/monitoring and research (USFWS 2013, p. 21). California Gulch/Warsaw Canyon and Sycamore Creek are known routes for drug traffickers and undeclared migrants (Ibid., p. 18).

According to the Service, the construction of walls along portions of the international border in 2019-2021 likely increased cross-border traffic and the associated law enforcement response into non-fenced areas near California Gulch and Sycamore Canyon (USFWS 2022a, p. 4-5).

Based on the web map made available by the Wildlands Network (Traphagen 2021), a section of border wall was built from approximately Sasabe, to the west of California Gulch, to about Sycamore Canyon in the east. A series of "wildlife gaps" exists in this wall (Figure 3), including one in California Gulch, which is also within Jaguar critical habitat – "Jaguar Atascosa Gap B" (Figure 4) (Wildlands Network 2021). Although Sonora chub are small enough to move between the border wall's steel bollards (and any small wildlife passages if present (CBP 2022a, p. 5)), Jaguar Atascosa Gap B (hereforth "the gap" in California Gulch) is crucial for preserving as much cross-border habitat for the Sonora chub as possible, even if habitat restoration at the gap is likely also needed (Figures 4 and 5). Indeed, while it is unclear if conditions have changed since the pictures were taken (CBP 2022b, p. 6 and associated recording ("CBP webinar recording")[5]; CBP 2022c, p. 3, 5), in the first image of the gap, one can see what appears to be a raised road either side of the stream. In the second image, one can see the stream dammed with rock and debris that were piled up by monsoonal flooding against a layer of mesh wire installed behind the vehicle barriers in the gap. It is unclear if Sonora chub are able migrate across the border under current conditions.

In addition to conditions at the gap, and the border wall itself, which is likely causing erosion and sedimentation in the chub's habitat[6], in January 2022, U.S. Customs and Border Protection (CBP) depicted the conditions of the wall projects within the Tucson Sector as of July 2021 (CBP 2022d, entire). In California Gulch, there is a rockfall (scree slope)[7], a damaged cattle guard, and a patrol road extension[8] approximately where the stream bed crosses the border. There are also two staging areas[9] and more patrol road extensions within ~0.5 miles, and a larger staging area approximately on the western edge of Sycamore Canyon (see impact point and area features on the map in CBP 2022d). CBP proposed to replace the cattle guard and implement erosion control measures for the scree slope and re-seed the patrol road extensions and staging areas outside the Roosevelt Reservation as part of its Border Barrier Remediation Plan (Ibid.). It

[5] Recording courtesy of Ryan Devereaux, staff investigative reporter at The Intercept.

[6]Although it is possible that erosion control has been conducted (CBP webinar recording; CBP 2022c, p. 3), as will be seen below, there are no plans to remove the border wall itself, which means that the threat of erosion and sedimentation continues.

[7] A rockfall denotes rocks that have been pushed down a slope. Hillsides were cut into to build the border barrier and associated patrol and maintenance roads. However, not all cuts were stabilized, resulting in rocks falling or having the potential to fall (CBP 2022d, p. 4-5).

[8] A patrol road extension is a disturbed area outside of the 60-foot Roosevelt Reservation used for construction traffic or material storage (CBP 2022d, p. 4).

[9] A staging area is an area used to store materials and vehicles for constructing the border barrier (CBP 2022d, p. 5).

also proposed to finish a culvert approximately where the California Gulch gap is, and two other culverts within the approximately 0.5-mile radius (Ibid. and CBP 2022d, p. 3). While the overall impact on the hydrology of the area is unclear, culverts often do not allow fish passage (NOAA 2019, p. 1).

The CBP's April 2022 Tucson Sector Border Barrier Remediation Plan Public Feedback presentation (CBP 2022c) includes a list of items being incorporated into the Tucson Sector Remediation Plan: erosion control and slope stabilization, restoration and reseeding of disturbed areas, removal of construction material, removal of built-up debris at low water crossings, restoration of specific CNF access roads, and closing of gaps (see below) (CBP 2022c, p. 7). The presentation also suggests that long-term environmental mitigation projects will be conducted if funding is available (Ibid., p. 3). The CBP webinar recording (from September 2022) similarly mentions a list of activities to be conducted by CBP such as "permanent erosion and sediment control […] hardening and stabilizing slopes, ensuring that drainage is proper along the border […] ensuring that water flow is flowing as intended […] restoring and decommissioning temporary used roads and way down[10] areas" (CBP webinar recording). It is further noted that "in areas where original topography cannot be restored, CBP will put in measures to avert further environmental damage or degradation by stabilizing those areas". Within the Tucson sector specifically, it is suggested that road decommissioning may occur in the CNF and that "CBP will finish drainages and low water crossings in some cases, reengineering the design to allow for water flow[11]" (Ibid.). Long-term environmental mitigation includes projects such as habitat mitigation and restoration[12] although it is unclear if funding is now available for the Tucson sector specifically. Additional funds were authorized in July 2022 for additional environmental remediation and mitigation and other activities but the exact location or nature of the activities to be performed is unknown (CBP 2022b, p. 5 and CBP webinar recording).

While the Sonora chub may come to benefit from at least part of the planned environmental restoration and mitigation work, there are currently no plans to remove the border wall itself (CBP webinar recording). In addition to the aforementioned projects, it seems likely that the gap in California Gulch, which is roughly 100 feet wide (see map in CBP 2022d)[13] will be closed. It was reported in CBP 2022c, that "25 small gaps and gates" would be closed (CBP 2022c, p. 8), and reported by Arizona Public Media that "25 gaps of up to 100ft wide" would be closed

[10] Meaning unknown. The actual word is likely different from that which was discerned from the recording. The slides shown during the webinar refer to the restoration, repair and decommissioning of roads (CBP 2022b, p. 6).

[11] This comment was made in response to concerns regarding the closure of gates and flooding in specific areas so it is assumed that water flow in this case means cross-border water flow.

[12] A similar but different list of projects is included in CBP's April 2022 Tucson Sector Border Barrier Remediation Plan Public Feedback presentation (CBP 2022c) (p. 5)

[13] But possibly no greater than 50 ft (see Sky Island Alliance Arizona Border Briefing (Nov. 1, 2022) recording https://skyislandalliance.org/2022/11/arizona-border-briefing/ [accessed February 2023])

(Reznick 2022, p. 2) (see also Sky Island Alliance and Wildlands Network 2022, p. 1, for potential size of gaps to be closed).

The CBP webinar recording details how, in some cases, small gaps in the border wall "were intended to be gates for drainage or access to border monuments. As part of the remediation contract those gates will be installed. In other cases, small gaps were created when two construction headings met, and the gap was not completed as the construction was rolling to a stop. These gaps will also most likely be closed as part of the remediation project. Gates and associated foundation work will be completed, small gaps will be filled." (CBP webinar recording). While it is unclear which one of these "remediation" actions would apply to the gap in California Gulch, both are a threat to the Sonora chub. Adding more border wall would hinder chub migration and likely lead to more flooding by restricting water flow, including through causing debris and trash accumulation against the wall. A slower streamflow could also cause transported sediment to settle out, filling in chub habitat. A higher streambed would additionally mean that water flowing on top of it could take more vegetation with it, leading to more debris build-up at the wall (Reese 2019, p. 3, 5). If a gate is conversely installed at the gap, it is not at all evident that it would be open anytime a cross-border hydrological connection exists. Additional measures to preserve water flow could help but it is unknown if any such measures would be implemented at the gap or whether these would be consisted with the habitat needs of the Sonora chub. Habitat disturbance would also occur during the construction phase alone.

One of the contracts being awarded for the Tucson sector had an anticipated start date of October 2022 and covers 71 miles from the Sasabe port of entry to Nogales (CBP webinar recording), which means that work may begin in California Gulch sooner rather than later. A critical habitat designation in California Gulch would protect the Sonora chub now, and in the future, which is important given that border matters are inherently fluid and subject to shifting priorities.

Figure 3. Wildlife gaps in the border wall. Gaps are shown by a deer icon, of which there are 27. Only 23 of these count as wildlife gaps, however, with the remainder representing the west and east end of the wall, monument 131 and Cerro east, at more than 2000 ft wide (Wildlands Network 2021).

Figure 4. Jaguar Atascosa Gap B (Wildlands Network 2021). August 24, 2021.

Figure 5. Another image of the gap in California Gulch, taken in 2021 and looking towards Mexico.

5. *Recreation*

Both Sycamore Canyon and California Gulch are found on the CNF and used for recreation, which requires the construction and use of roads and trails. Road reparation and use may cause the degradation, siltation, and pollution of corridors and channels and negatively impact the Sonora chub (USFWS 2013, p. 17). Recreational use of these roads and trails, coupled with high levels of border activity by both undocumented immigrants and border patrol in this area, also increases the likelihood of non-natural contaminants entering the water supply (Ibid.). Moreover, only a portion of Sonora chub habitat is closed to motorized and mechanized vehicles and equipment, which may contribute to erosion (USFWS 2013, p. 5-6). Erosion may in turn lead to stream pollution, alter channel morphology and fill in available habitat.

B. Disease or Predation

The health of the Sonora chub populations is at risk due to the presence of Asian tapeworms, non-native fish, and bullfrogs.

The Asian tapeworm (*Bothriocephalus acheilognathi*) is an invasive parasite found in fishes of the Rio Yaqui watershed, including the Yaqui chub. Sonora chub can hybridize with Yaqui chub, which means their potential for exposure to the tapeworm is high, and because they are in the same genus, effects are likely to be similar. In Yaqui chub, becoming infected with the tapeworm can affect growth rate and cause intestinal blockage (USFWS 2013, p. 19). In addition to congeneric *Gila,* Sonora chub may become exposed to Asian tapeworm through non-native fish introduced from infested watersheds (USFWS 2013, p. 18-19). According to Stefferud and Stefferud (2007), non-natives in California Gulch include green sunfish, bluegill, largemouth bass, black bullhead and western mosquitofish, and these are fed into the system from impoundments at Ruby. They persist in the channel in perennial pools immediately upstream from the tinaja (Stefferud and Stefferud 2007, p. 18). USFWS (2013) also report the presence of bluegill of uncertain origin. Potential sources of these and other non-native fish include tanks and private lakes in the upper portions of the Sycamore Creek and California Gulch watershed. In addition, bluegill are found in nearby Arivaca and Pena Blanca Lakes (USFWS 2013, p. 20). In October of 2021, the Center documented green sunfish (*Lepomis cyanellus*) and largemouth bass (*Micropterus salmoides*) fry in California Gulch, including numerous green sunfish residing within the upper exclosure tinaja. In Mexico, bluegill, green sunfish and black bullhead have been observed with the Sonora chub on the Rio Magdalena, and it is likely that no non-native species management actions are being implemented and/or these are having the same lack of success as in the United States (USFWS 2019, p. 2).

The main threats to Sonora chub from non-natives are predation and competition. Bluegill and largemouth bass compete with and predate upon Sonora chub (USFWS 2013, p. 11, 20). Climate change impacts may also reduce shared resources between non-native fishes and Sonora chub, thus increasing the effects of competition, predation, and/or Asian tapeworm infestation (USFWS 2019, p. 3) Another non-native species threatening the Sonora chub is the American bullfrog (*Lithobates catesbeianus*). Bullfrogs have been found in areas surrounding Sycamore Canyon and California Gulch and within both drainages, and are known predators of native fish and fish eggs (Ibid., p. 20).

C. Overutilization

In 2009, Sonora chub were captured in Ronquillo pond, a restored leopard frog locality less than 1 mile from, and within the watershed of Pena Blanca Lake. It is likely the individuals were

unlawfully transferred and used as baitfish. However, since this appears to have been an isolated event, the threat of human fishing and transportation of the fish is considered to be low (USFWS 2013, p. 19).

D. Inadequacy of Existing Regulatory measures

1. *U.S. Forest Service*

The majority of habitat occupied by Sonora chub within the U.S. exists within the CNF and a portion of that habitat occurs within the Pajarita Wilderness and Goodding Research Natural Area (RNA), which supposedly lends it a high degree of administrative protection (USFWS 2013, p. 21). Management direction for Sycamore Canyon portions of habitat within the Gooding RNA and/or wilderness is indeed to maintain the area in climax vegetation and prevent removal of minerals, livestock grazing, use of motorized or mechanized vehicles or equipment, harvest of timber or fuelwood, and the use of recreation, unless non-developed or dispersed (USFWS 2013, p. 5; USFWS 2017a, p. 205). However, livestock grazing within the wilderness outside of the RNA is permitted (USFWS 2017a, p. 205) and neither the wilderness nor the RNA management plans contain specific protections for Sonora chub (USFWS 2019, p. 4).

The rest of Sycamore drainage and California Gulch is open to multiple uses (USFWS 2017a, p. 205) and only broad conservation objectives are included in the Coronado National Forest (CNF) Land and Resource Management Plan (LRMP) (USFWS 2019, p. 4). In addition, Sonora chub are no longer included in the Regional Forester's List of sensitive species (USFWS 2013, p. 21).

2. *U.S. Fish and Wildlife Service*

The establishment of a captive population at the ASDM is the primary measure taken to preserve the Sonora chub since its listing. The ASDM is a refugial site outside of the species' range that currently has 400-500 individuals in captivity (USFWS 2022a, p. 5). This population provides some assurance that if a wild population is extirpated, it can be replaced. ASDM can also be used as a refugium if needed (Ibid.), and as place to conserve displaced fish if preemptive action is taken prior to a known activity such as a wildfire suppression activity (USFWS 2013, p. 18, 29). However, a significant limitation of captive populations is that, due to a lack of any natural genetic exchange, they are susceptible to losing genetic diversity and expression of deleterious recessive genes (USFWS 2009, p. 20). Maintaining genetic diversity depends entirely on the periodic transfer of fish caught in the wild (USFWS 2013, p. 11; USFWS 2019, p. 10). In addition, the genetic composition of Sonora chub populations in the wild remains unknown, which makes it impossible to know if the current population at ASDM represents the Sonora chub's natural variation (USFWS 2019, p. 10).

Captive populations are also by definition reliant on the continued maintenance of artificial facilities. Although not a locality for a truly captive population, Hank's and Yank's tank has previously served as a reserve population (USFWS 2013, p. 7; USFWS 2019, p. 10; USFWS 2022a, p. 5). However, flooding in January of 1993 eroded the banks under the tank and exposed leaking pipes and fittings beneath the structure. The pipes and the tank had to be repaired, and had the tank failed during repairs and translocation not been possible, all Sonora chub could have been incidentally taken (USFWS 2013, p. 25).

The other conservation measure that will have helped preserve the Sonora chub is the approximately 42 interagency consultation and technical assistance efforts involving the species and/or its current critical habitat (USFWS 2013, p. 24). Eleven of these consultations were technical assistance letters to non-Federal project proponents, with review comments or recommendations. Four consultations were lists of species to inform projects. Fifteen consultations were informal and included projects such as bullfrog removals and power-line constructions, with one project yet to be completed (Ibid.). Eleven consultations were formal, including several that were deemed to have effects of sufficient scale to affect the status of the Sonora chub such as the Hank's and Yank's tank repair project (USFWS 2013, p. 24-25). Other projects included the renewal of the Coronado National Forest's Montana Allotment grazing management plan, implementation of Standards and Guidelines of the Land and Resource Management Plans for the 11 National Forests in the Southwestern Region, federal funding of the AZGFD sportfish stocking program and the Forest Service's use of fire retardant (Ibid., p. 25-26)[14].

Efforts have also been made to remove non-native fish from Sonora chub habitat but these remain a major threat to the species (USFWS 2019, p. 2, 7). The Service has additionally determined that Sycamore Canyon and California Gulch are within the Tucson Active Management Area, which is managed by Arizona Department of Water Resources (ADWR) (Ibid, p. 6). However, as described in Section A, instream flow water rights have not been acquired and surface waters are not protected from groundwater pumping. Consideration of the presence of endangered or threatened species in water resource management and supply development also appears to be at the discretion of ADWR (USFWS 2019, p. 6).

3. *Mexico*

Land ownership patterns are variable and there is comparatively little administrative protection for the Sonora chub (USFWS 2022a, p. 6). No refugia or captive populations of the species are

[14] A Draft Supplemental Environmental Impact Statement supplementing portions of the 2011 Nationwide Aerial Application of Fire Retardant Final Environmental Impact Statement has been published (USFS 2022, p. i) and includes a may affect and is likely to affect determination for Sonora chub and its current critical habitat (Ibid., p. 98, 117).

known to exist (Ibid., p. 5) and it is likely that non-native species management actions are either not being implemented and/or experiencing the same lack of success as in the U.S. (USFWS 2019, p. 2).

E. Other factors

1. Fire

Several southwest fires have recently burned at stand-replacing intensities and proportions, while other fires have been smaller and burned in a (mosaic) pattern healthier for forests (USFWS 2013, p. 17). The 2011 Murphy Fire burned through 68,079 acres, including portions of the CNF, with a low to moderate intensity over 97% of this area. Part of Sycamore Canyon was burned, including Sonora chub critical habitat. Although the amount of suitable habitat for Sonora chub did not change significantly, effects to both the Sonora chub and its critical habitat included ash and sediment deposits (Ibid.). The 2016 Mule Ridge fire burned small portions of both the Sycamore Canyon and California Gulch watersheds and also reached the channel of Sycamore Canyon. Although the fire likely did not result in long-term harm to Sonora chub or its critical habitat, a more intense and/or larger scale wildfire could have serious adverse effects (USFWS 2017a, p. 206). On May 16, 2021, the Warsaw Fire began burning approximately 950 acres of grass and bush in the terrain near Warsaw Canyon in the CNF, immediately west of California Gulch. The severity, frequency and extent of wildfires in Arizona is likely to increase in the future due to higher temperatures and drought (EPA 2016, p. 2). There is also an increased fire risk associated with the increased human traffic along the US/Mexico border (USFWS 2013, p. 21).

The use of fire retardant is another threat to the survival of the Sonora chub due to the effects of acute toxicity to fish and other aquatic organisms (USFWS 2013, p. 26). Although buffer ways have been established around waterways, one misplaced fire retardant drop (or one severe fire) could drastically impact or possibly extirpate one of the Sonora chub populations, or significantly affect the species' genetic diversity, limiting the recovery potential of Sonora chub (USFWS 2013, p. 18). In addition, the mainstem streams of Sycamore Canyon and California Gulch are only approximately 3 miles apart, with their headwaters almost adjacent in some areas. A single wildfire could therefore reasonably affect both streams. Similarly, a misapplication of retardant could kill fish, affect spawning, and/or reduce occupied habitat in both streams (USFWS 2011, p. 246).

2. Drought and climate change

Temperatures in Arizona have increased by about 2.5°F since the beginning of the 20th century. The first 21 years of the 21st century have been the warmest in the state since records began.

Precipitation is highly variable from year to year, but the driest multi-year period occurred during the early 1900s, immediately prior to the wettest multi-year period. The period since 1995 has also been relatively dry, with 17 of the last 26 years experiencing below average precipitation (NOAA 2022, p. 3). Annual monsoon precipitation is also highly variable but has been below average since 2000, except for 2010 to 2014, which was above average. The monsoon season in 2020 was the driest on record. Based on the Palmer Drought Severity Index for Arizona, there have been periodic prolonged wet and dry periods from the year 1000 to the year 2020, with the current long-term drought lasting more than 20 years (Ibid, p. 4).

Historically unprecedented increases in annual average temperature are projected during this century under a higher emissions pathway. The hottest end-of-century projections are about 11°F warmer than the hottest year in the historical record. Under a lower emissions future, the coldest end-of-century projections are about 2°F warmer than the historical average (NOAA 2022, p. 1). Although annual precipitation projections are uncertain, there is also a risk of spring precipitation decreasing. In addition, projected rising temperatures will increase the likelihood of precipitation falling as rain rather than snow, reducing water storage in the snowpack. High spring temperatures will also lead to earlier melting of the snowpack (Ibid, p. 5). During the cool season, naturally occurring droughts are expected to become more intense. Even if precipitation does not decrease, higher temperatures will increase water evaporation, which will intensify the droughts (Ibid.).

According to the Service, climate change is the most serious threat to Sonora chub (USFWS 2019, p. 4), with (among other potential changes), projected increases in Southwest temperatures and a probable decrease in overall annual mean precipitation (IPCC 2007a, b as cited in USFWS 2019, p. 6). Changes in temperature and stream flow (Weiss and Overpeck 2005 and Seager et al. 2007 as cited in USFWS 2019, p. 6) are predicted to decrease the amount of Sonora chub habitat within the United States, worsen habitat conditions throughout the species' range, have both direct and indirect ecological impacts on the species, and strengthen the impact of other threats (USFWS 2019, p. 6). Climate change may for example increase competition with, and possibly predation by, non-native fish by reducing shared resources (USFWS 2013, p. 20). In addition, despite increasing drought conditions, the magnitude and/or frequency of flooding is anticipated to increase. Sonora chub persisting at lower abundance in drought-reduced habitat will be subject to larger and/or more frequent floods that may further lower abundance and/or the species' ability to recolonize upstream habitats following its displacement to downstream reaches (USFWS 2019, p. 6). Moreover, climate conditions influence the water available to both water development and aquatic habitats, with the former usually prioritized over the latter (USFWS 2014, p. 51056).

3. Hybridization

The status of the Sonora chub could be affected by the presence of an undescribed *Gila* that is syntopic and hybridizing locally with Sonora chub near La Atascosa, Sonora, Mexico. However, further genetic study is required to confirm that hybridization is occurring and threatening Sonora chub (USFWS 2019, p. 10).

VI. CURRENT CRITICAL HABITAT DESIGNATION

As described in the 1986 final listing rule for the Sonora chub, Section 3 of the Endangered Species Act defines "critical habitat" as: "(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." (USFWS 1986, p. 16044).

Physical or biological features essential to the conservation of the species is defined as "the features that occur in specific areas and that are essential to support the life-history needs of the species, including, but not limited to, water characteristics, soil type, geological features, sites, prey, vegetation, symbiotic species, or other features" (50 CFR 424.02). Conservation is defined as "to use and the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary, i.e., the species is recovered in accordance with § 402.02 of this chapter." (Ibid.).

In accordance with Section 4(a)(3) of the Act, critical habitat must be designated at the same time as a species is determined to be endangered or threatened, to the maximum extent prudent and determinable (USFWS 1986, p. 16044). A critical habitat designation may not be prudent under circumstances that include but are not limited to: (i) the designation would exacerbate threats of taking or other human activity; (ii) the species is not threatened by the present or threatened destruction, modification, or curtailment of a species' habitat or range, or threats to the species' habitat are solely due to causes that cannot be addressed through management actions resulting from consultations under section 7(a)(2) of the Act; or (iii) there are no areas meeting the definition of critical habitat (50 CFR 424.12). A critical habitat designation is not determinable when (i) data needed to perform required analyses are lacking; and/or (ii) the biological needs of the species are too poorly known to identify any area meeting the definition of "critical habitat" (Ibid.).

Critical habitat was designated for Sonora chub concurrently with its final listing rule in 1986 and included the entire area in the US where the species was known to occur at that time

(USFWS 1986, p. 16044). This consisted of "Sycamore Creek, starting from and including Yank's Spring, downstream to the International Border with Mexico, plus the lower 1.25 miles of Penasco Creek, and the lower .25 miles of an unnamed stream that enters Sycamore Creek from the west in the NW ¼ of Section 23, T.23S., R.11E. in Santa Cruz County, Arizona" (Ibid.). Also included was a 25 foot wide riparian area along each side of Sycamore and Penasco Creeks. This riparian zone is essential for maintaining the creek ecosystems and the stream channels, and thus for conservation of the species. No riparian zone was designated for Yank's spring as the spring is impounded in a concrete tank and does not have a riparian zone. The unnamed stream portion of the critical habitat also does not have a designated riparian zone because it consists of bedrock pools that are relatively unaffected by the riparian zone (Ibid., p. 16044-16045).

Yank's Spring, Sycamore Creek and two of its tributaries were designated as critical habitat because they supported the only U.S. population of Sonora chub known at that time. The designated area was described as providing "all of the ecological, behavioral, and physiological requirements necessary for the survival of this chub" (USFWS 1986, p. 16045). Physical or biological features that are essential to the conservation of the Sonora chub were not identified in the final rule. However, subsequent biological opinions describe important habitat characteristics (the equivalent of "primary constituent elements") as including "clean permanent water with pools and intermediate riffle areas, and/or intermittent pools maintained by bedrock or subsurface flow in areas shaded by canyon walls" (USFWS 2017a, p. 112, and USFWS 2011, p. 241 and USFWS 2015, p. 50, albeit with varying punctuation). USFWS 2017a also argued that the final rule discussed the types of activities that could modify critical habitat, with the implication that these are critical elements (CE) (USFWS 2017a, p. 291). These activities are summarized in USFWS 2017a (p. 291-292) as follows: CE 1. Any activity depleting flows or significantly changing the natural flow regime in the critical habitat reaches; CE 2. Any activity that would extensively change the critical habitat reaches' channel morphology; CE 3. Any activity that would significantly change the critical habitat reaches' water chemistry; CE 4. Any activity that would introduce exotic fish and their parasites to the critical habitat reaches. Finally, USFS 2019 writes: "At the time the final rule was written, the following was discussed for the constituent elements: the area provides all of the ecological, behavioral, and physiological requirements necessary for the survival of this species." (USFS 2019, p. 20).

VII. REQUESTED REVISION OF CRITICAL HABITAT

This petition seeks to revise the current critical habitat designation to include California Gulch, which was found to be occupied by Sonora chub in 1995 (USFWS 2013, p. 13).

Per 50 CFR 424.14(e), information to be included in petitions to revise critical habitat include: (i) a description and map(s) of areas that should be included or excluded, and a description of the benefits of including or excluding these specific areas as critical habitat; and (ii) a description of

physical or biological features essential for the conservation of the species and whether special management considerations or protection may be required for these. For petitions seeking to add or remove critical habitat areas that were outside the geographical area occupied by the species at the time it was listed, (iii) information must also be provided as to why the petitioned areas are or are not essential for the conservation of the species. This third criteria is also paraphrased in the Service's 90-day finding petition review form for the Center for Biological Diversity's 2021 critical habitat revision petition for the Sonora chub as follows; "California Gulch was not considered occupied at the time of the Sonora chub's listing. As set forth in our regulations, the petition must include information that area petitioned to be added that were outside the geographical area occupied at the time of listing is essential for the conservation of the species (50 CFR 424.14(e)(5))." (USFWS 2022b, p. 4).

1. *Proposed area to be included and essential features*

This petition seeks to revise the current critical habitat designation to include, at the very minimum, the stretch of California Gulch downstream from the small dam just above the tinaja to the international border (Figure 6). This area includes perennial pools and intermittent stream channel (Stefferud and Stefferud 2007, p. 18)[15], which is conducive to Sonora chub survival during dry periods as well as expansion to newly wetted habitat during wet periods. Available habitat upstream of the dam should also be included for additional recovery habitat. As noted in section IV, there appears to be 2 (stream) miles of suitable and potential Sonora chub habitat available above the tinaja dam (USFS 2019, p. 19). Perennial water is also present in at least part of this area. In addition, this section of the stream is particularly impacted by cattle and flows directly into the tinaja exclosure. It is additionally important to designate a riparian zone along each side of the stream channel, and for the width of the riparian zone, we propose 25 feet as in USFWS 1986 (USFWS 1986, p. 16044). Riparian vegetation can help maintain clean water by removing excess nutrients and sediments from surface runoff (NPS 2022, p. 1). Riparian zones also stabilize stream banks, which is essential for preserving channel morphology, and can offer shade to streams, reducing the water temperature in the chub's habitat (USFWS 2017a, p. 110; NPS 2022, p. 1).

[15] There is the tinaja perennial pool (Stefferud and Stefferud 2007, p. 18), as well as perennial pools between the tinaja and the tinaja dam, which we assume are also the "perennial pools immediately upstream from the tinaja" being referred to in Stefferud and Stefferud 2007 (p. 18). There is additionally perennial water in the border exclosure (Ibid.)

Figure 6. Map of the proposed area to be added to critical habitat. The 25 ft riparian zone is approximated by the proposed critical habitat line due to the scale of the map. The proposed critical habitat also approximates distances described in the text as it includes 2.2 miles of stream from the border to the small dam above the tinaja ("Dam") at 31.406499, -111.238929, and 2 miles of stream from the dam leading north.

2. *Essential features require protection*

The proposed area is threatened by activities that could modify essential habitat features and/or elements and protection against these activities could to a large extent be achieved through Section 7 consultation and other benefits associated with critical habitat (see section 3).

Future mining operations within the watershed of California Gulch may lead to pollution of the chub's habitat as well as increased groundwater withdrawal and subsequently reduced streamflow, potentially drying up important pools, runs or riffles.

Livestock grazing may reduce streamflow by degrading watershed conditions and potentially through increased consumption of groundwater. It may also lead to increased erosion of stream banks, resulting in altered channel morphology. Sedimentation associated with trampled banks and pollution caused by excrement (Batchelor et al. 2015, p. 931) additionally threaten water quality. Other direct effects of livestock grazing on critical habitat may include: 1) increased water temperatures due to stream channels becoming wider and shallower, 2) nutrient loss within the stream channel due to a decrease in the number, size and depth of pools, 3) reduction in cover and subsequent increase in temperature due to grazing on riparian vegetation and banks sloughing off due to livestock trampling (USFS 2019, p. 21).

Border activity and infrastructure are likely causing erosion and pollution in the Sonora chub's habitat. Further impacts are also anticipated due to proposed border barrier remediation actions, with potentially drastic consequences for the Sonora chub.

The use of motorized or mechanized equipment for recreational purposes is another potential threat as this may also lead to erosion.

Wildfires are anticipated to increase in severity and/or frequency, which means that aerial application of fire retardant on CNF is likely to continue, and indeed USFS has proposed to continue its use as described in the 2011 Record of Decision, with some modifications (USFS 2022, p. i). There needs to be continued accounting and mitigation of impacts to Sonora chub from applications, including specifically impacts to (proposed) critical habitat in California Gulch. A misapplication of retardant would jeopardize the clean water Sonora chub need to survive and likely change the biodiversity and trophic dynamics in the stream, negatively impacting the Sonora chub's food source (USFWS 2011, p. 247). Other types of fire suppression activities (USFWS 2011, p. 27), if implemented, may also be threats given the extremely limited amount of habitat available to the chub.

Non-native fish have been found in Sonora chub habitat, nearby water bodies and continue to be stocked by AZGFD, which means that there may be the potential for illegal, or accidental, transfer of non-native fish and their parasites into California Gulch.

3. *Benefits of inclusion of proposed area*

The primary benefit of expanding critical habitat to the proposed area is consultation under section 7 of the ESA and according to USFWS, "the presence of Sonora chub there [in California Gulch] ensures that consultations for actions within the area are completed", which means revising the existing critical habitat designation is not necessary (USFWS 2013, p. 4-5).

However, Section 7 dictates that federal agencies consult with the Service not only to ensure that the actions they fund, authorize, permit, or otherwise carry out do not jeopardize the continued existence of any listed species, *but also to ensure that these do not "destroy or adversely modify designated critical habitat"* (USFWS 2022c, p. 1). Thus, as the law prohibits both jeopardy to a listed species' continued existence and destruction or adverse modification of its critical habitat, the two standards are not interchangeable in consultations. In addition, "jeopardize the continued existence of" is defined in 50 CFR 402.02 as engaging in "an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species", and "destruction or adverse modification" is defined as "a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species." Thus, whereas the "jeopardy" standard requires that the likelihood of survival and recovery both be appreciably diminished, the "destruction and adverse modification" standard can serve to limit actions that affect recovery (see conservation definition in 50 CFR 424.02) even when the value of critical habitat for survival is not appreciably diminished.

In 2021, the Service also noted that (USFWS 2021a, p. 62616):

A consultation on effects to the species (including effects resulting from changes to the non-designated habitat of the species) as part of the ''jeopardy'' prong looks primarily at how the project affects individuals, populations, and the species rangewide. Consultation on the effects to the designated critical habitat (the ''critical habitat'' prong of the consultation) focuses on that habitat network. This reflects Congress's clear articulation of two limits on Federal actions in section 7: A prohibition against jeopardizing the species, and a prohibition against destroying or adversely modifying its designated critical habitat. While we do evaluate the effects of landscape level impacts to habitat as part of the jeopardy analysis, this does not mean that the analysis of impacts to critical habitat are no longer necessary; the two analyses are not necessarily interchangeable.

A critical habitat designation can, furthermore, help federal agencies identify when consultation under section 7 is required, particularly in cases where no direct mortality or injury to individuals of a listed species is anticipated to occur as a result of the proposed action (USFWS 1993 as cited in Center for Biological Diversity 2000, p. 17).

Designating critical habitat in California Gulch would also provide benefits to the Sonora chub beyond those directly associated with the outcome of section 7 consultations. It would, for example, warn actors about the presence of the Sonora chub in California Gulch and give notice of the existence of important habitat and potential land use restrictions. The designation may also encourage proponents of future projects to avoid impacts to the chub's habitat in order to bypass the consultation process (Kendrick 2021, p 92).

The critical habitat designation may additionally affect section 9 of the ESA, which prohibits the take of an endangered species (Kendrick 2021, p. 92), and in certain cases, threatened species (Congressional Research Service 2021, p. 17-18). Based on ESA case law, a court is more likely to find violations of other sections of the ESA if critical habitat is affected by an action (Kendrick 2021, p. 92). Although the Sonora chub's 4(d) rule allows take to occur under certain conditions for educational and scientific purposes, zoological exhibition, conservation purposes consistent with the ESA, and by state licensed recreational fishermen, other section 9 prohibitions still apply (USFWS 1986, p. 16045-16046). Designated critical habitat may also trigger additional environmental review under other federal laws, helping reinforce careful consideration of an action's effect on the environment. Significant effects to designated critical habitat (even if not meeting the "destruction or adverse modification" standard under the ESA) could for instance lead to additional review under the National Environmental Policy Act (USFWS 2021a, p. 62647).

Benefits of a critical habitat designation in California Gulch would also include those accrued by other fauna and flora and by people. California Gulch is part of the Atascosa Highlands International Bird Area and includes riparian birds such as the tropical kingbird (*Tyrannus melancholicus*), the black-capped gnatcatcher (*Polioptila nigriceps*), the five-striped sparrow (*Amphispizopsis quinquestriata*), which are all Species of Conservation Status (National PIF Watchlist) (NatureServe 1996a, b, c, p. 5; Audubon 2022, p. 2). It also includes critical habitat for the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), a federally protected riparian bird (USFWS 2021b, p. 20851). Protecting the Sonora chub's habitat will thus help protect these birds and the recreational value associated with California Gulch, a popular birding destination. Preserving the area's aesthetics and clean water is likely important here too, both of which are susceptible to degradation in the absence of critical habitat. California Gulch also includes Jaguar (*Panthera onca*) critical habitat, including at the gap (see Wildlands Network 2021).

We are not aware of any benefits of excluding the proposed area from critical habitat. In addition, an area may not be excluded from critical habitat regardless of benefits, if it will result in the extinction of the species concerned (USFWS 2017b, p. 1 and 50 CFR 424.19). Yet, as discussed in more detail below, failure to designate critical habitat in California Gulch may cause the Sonora chub to go extinct.

4. *Proposed area is essential to the conservation of the species*

Designating critical habitat in California Gulch is essential to the conservation or "recovery" (50 CFR 424.02) of the Sonora chub as defined in its recovery plan. Although recovery criteria for the species have not been developed, the recovery plan includes recovery objectives, the implementation of which are designed to: (1) maintain Sonora chub populations in all extant locations; (2) monitor non-native fishes' presence and remove these fish as necessary; (3) protect existing habitat from degradation; and (4) implement public education in the United States and Mexico (USFWS 2013, p. 3, 15). One of these recovery objectives is to "recognize critical habitat" to "protect remaining populations of Sonora chub" (USFWS 1992a, p. 22). The existing critical habitat falls short of this objective, however, since it was designed to only protect the Sycamore Canyon population, the only known population at the time of the designation (USFWS 1986, p. 16044-16045).

Protecting Sonora chub habitat in California Gulch is also essential to the survival and recovery of the species as it allows for increased redundancy, resiliency and representation, and therefore viability. A species can be said to be recovered when its continued viability is highly certain (USFWS 1992b, p. 1822). Redundancy describes a species' ability to withstand catastrophic events, i.e., a rare destructive natural event or episode that involves many populations and occurs suddenly. Redundancy is about spreading the risk and can be measured based on the number and distribution of resilient populations across the species' range. The more resilient populations there are over a larger landscape, the better a species can withstand catastrophic events (USFWS 2018, p. ix). Resiliency describes a population's ability to withstand either periodic or stochastic disturbance events that do not rise to the level of catastrophic. It is positively related to population size and health and may depend on habitat factors such as flow, connectivity, and geomorphology. In general, populations need an abundance of individuals within habitats of adequate area and quality to continue surviving and reproducing in spite of disturbance (Ibid., p. 114). Representation describes a species' ability to adapt to changing environmental conditions over time. Representation can be measured based on the range of adaptive diversity within and among populations and the ecological diversity of populations across the species' range. The more representation, or diversity, there is in a species, the more the species can adapt to environmental changes (Ibid., p. 4).

California Gulch is one of just two wild populations of Sonora chub in the U.S., which means that without it, the redundancy of the Sonora chub is likely extremely low. As described above, a catastrophic event such as a severe fire or a misplaced fire retardant drop could severely impact or even remove one of the populations, or significantly affect the species' genetic diversity, limiting the ability of the Sonora chub to recover (USFWS 2013, p. 18). Designating critical habitat is necessary to ensure that the California Gulch population is resilient enough for the species to avoid extinction, given the species' status in Mexico and should the Sycamore Canyon population be extirpated by a catastrophic event, back-to-back stochastic events (USFWS 2022d, p. 11204), or the combined effect of multiple threats. Without critical habitat, the resiliency of

the Sonora chub population in California Gulch is at risk of declining further due to the impacts of threats such as grazing and border infrastructure development.

Protecting California Gulch is also essential to the survival and recovery of the Sonora chub to preserve the species' ability to expand its population through migrations: "The Sonora chub is a desert fish adapted to the fluctuations of a desert environment; after drought conditions it has been known to rapidly expand and recolonize California Gulch and newly re-wetted reaches. If habitat conditions along water ways can be maintained, then this ability to respond to favorable water conditions is encouraging for the population to avoid the danger of extinction" (USFWS 2013, p. 27). Habitat in California Gulch needs to be protected to ensure the survival and reproduction of residents and new migrants. A healthy California Gulch population may also ensure migration of individuals to Mexico and possibly Sycamore Canyon.

Representation or diversity within Sonora chub is difficult to determine as the Sonora chub's genetic variability in the wild remains unknown (USFWS 2019, p. 10) and information on morphological variability appears to be limited. According to AZGFD (2021, p. 1), Sonora chub may achieve lengths of up to 7.9 in (20 cm) in the U.S. whereas Sonora chub in Mexico may grow up to 10 in (25 cm) long. A high degree of genetic differentiation between populations in California Gulch and Sycamore Canyon is unlikely given at least occasional interactions may occur between the two. However, additional genetic diversity may exist due to variation in the habitats or niches occupied in the two locations, enhancing the species' ability to adapt to changing environmental conditions. Sycamore Canyon is an intermittent stream with a perennial-interrupted flow that comprises isolated pools or sometimes continuous flow in the approximately 6 miles upstream of the international border (Stefferud and Stefferud 2007, p. 44). The canyon is a mix of Madrean evergreen oak woodland and Sonoran desert-dominated habitat, and there are significant reaches of high-elevation riparian vegetation, with species including Fremont cottonwood, willow, velvet mesquite and scattered Arizona sycamore (Audubon et al. 2020, p. 1-2). California Gulch is a small intermittent to ephemeral stream with perennial water at the tinaja, the livestock exclosure at the border, as well as artificial ponds at Ruby (Stefferud and Stefferud 2007, p. 18)[16]. The canyon is unique with quality thornscrub habitat, a dense shrub layer on its steep sides (Audubon et al. 2020, p. 2).

It is also important to note that the Service's current interpretation of representation, which focuses on a narrow set of intrinsic species' characteristics facilitating future adaptation, is highly insufficient to capture its meaning in the scientific literature and other policy. Representation should include the inherent importance of intraspecific variation as well as extrinsic species' characteristics such as their role in ecological communities (Malcolm and

[16] We assume that the perennial water at the tinaja includes "the perennial pools immediately upstream from the tinaja" (Stefferud and Stefferud 2007, p. 18). There is also perennial water in the 2 stream miles above the tinaja dam.

Carter 2021, p. 1). Sonora chub is the only native fish in California Gulch (USFWS 2001 as cited in Center for Biological Diversity 2021, p. 4). Thus, it likely plays a fundamental role in the ecosystem's trophic dynamics. Potential food items include aquatic and terrestrial insects, and algae, and like other chubs, Sonora chub probably feed opportunistically, taking advantage of seasonally available resources (USFWS 1992a, p. 10-11). Potential predators of Sonora chub include coati (*Nasua narica*), raccoon (*Procyon lotor*), belted kingfisher (*Ceryle alcyon*), herons (*Ardeidae*), garter snakes (*Thamnophis spp*.), large predaceous insects and amphibians (Ibid., p. 9). Freshwater fish are known to provide fundamental ecological processes and functions such as trophic dynamics, nutrient cycling, productivity, ecosystem engineering and ecosystems connection through migrations (Mota et al. 2014, p. 111). Thus, designating critical habitat in California Gulch would not only help preserve diversity in Sonora chub, and therefore adaptative potential to environmental changes, but also preserve the diversity of ecosystems that exist within the range of the chub.

LITERATURE CITED

Arizona Game and Fish Department. 2021. Gila ditaenia. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 8 pp.

Audubon, AZGFD, Tucson Audubon Society and Birdlife Important Bird Area. 2020. Important Bird Areas: Mini Conservation Plan. Updated April 2020. Available at: https://aziba.org/wp-content/uploads/2022/01/MiniPlan_IBA_AtascosaHighlands.pdf (accessed September 2022)

Audubon 2022. California Gulch, Coronado National Forest. Available at: https://www.audubon.org/important-bird-areas/california-gulch-coronado-national-forest (accessed September 2022)

Batchelor, J.L., Ripple, W.J., Wilson, T.M., Painter, L.E. 2015. Restoration of Riparian Areas Following the Removal of Cattle in the Northwestern Great Basin. Environmental management 55: 930-942.

CBP 2022a. Tucson Sector Border Barrier Remediation Plan DoD 284 Funded Projects Stakeholder Feedback Report. Available at: https://www.cbp.gov/sites/default/files/assets/documents/2022-Mar/Stakeholder%20Feedback%20Report%20for%20Tucson%20Barrier%20Remediation%20Plan.pdf (accessed December 2022).

CBP 2022b. Border Barrier Remediation Public Feedback and Future Plans. September 14, 2022. Available at: https://www.cbp.gov/sites/default/files/assets/documents/2022-Sep/Border%20Barrier%20Remediation%20Update%20ENGLISH.pdf (accessed February 2023).

CBP 2022c. Tucson Sector Border Barrier Remediation Plan Public Feedback. Available at: https://www.cbp.gov/sites/default/files/assets/documents/2022-Apr/Tucson%20Sector%20Border%20Barrier%20Remediation%20Plan%20Public%20Feedback%20Presentation_0.pdf (accessed December 2022).

CBP 2022d. Seeking Input on Border Barrier Remediation in Tucson, AZ. January 2022. Available at: https://storymaps.arcgis.com/stories/690f5d8a40cc46e2bac8b2e9fdbb97d8 (accessed December 2022).

Center for Biological Diversity 2000. Petition to revise the critical habitat designation for the northern right whale (Eubalaena glacialis) under the Endangered Species Act. Available at: https://www.biologicaldiversity.org/species/mammals/North_Pacific_right_whale/pdfs/PETITION.PDF (accessed October 2022).

Center for Biological Diversity 2020. On the Brink, How Federal Agency Neglect is Killing Chiricahua Leopard Frogs. December 2020. 2021. Available at: On the Brink, How Federal Agency Neglect is Killing Chiricahua Leopard Frogs (accessed March 2023).

Center for Biological Diversity 2021. Petition to revise Sonora Chub (*Gila ditaenia*) Critical Habitat to reflect current status and to protect known occupied and recovery habitat in California Gulch. July 30, 2021. Available at: https://www.biologicaldiversity.org/species/fish/pdfs/sonora-chub-CH-REVISION-PETITION-20210730.pdf (accessed March 2023).

Center for Biological Diversity 2022. Sixty-Day Notice of Intent to Sue the U.S. Forest Service and the U.S. Fish and Wildlife Service for Endangered Species Act Violations for Failing to Ensure that Forest Service Authorized Cow Grazing on the Coronado National Forest Does Not continue destroying Western Yellow-Billed Cuckoo, Chiricahua Leopard Frog, and Northern Mexican Garter Snake Critical Habitat. February 28, 2022. Available at: https://www.biologicaldiversity.org/programs/public_lands/grazing/pdfs/coronado-NOI-20220228.pdf (accessed March 2023).

Congressional Research Service. 2021. The Endangered Species Act: Overview and Implementation. Updated March 4, 2021. Available at: https://sgp.fas.org/crs/misc/R46677.pdf (accessed November 2022).

EPA 2016. What Climate Change means for Arizona. August 2016, EPA 430-F-16-005. Available at: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-az.pdf (accessed November 2022).

Kendrick, I. 2021. Critical habitat designations under the Endangered Species Act in an era of climate crisis. Columbia Law Review, Vol. 121:1. Available at: https://www.columbialawreview.org/wp-content/uploads/2021/01/Kendrick-Critical_Habitat_Designations_under_the_Endangered_Species_Act_in_and_Era_of_Climate_Crisis.pdf (accessed December 2022).

Malcolm, J. and Carter, A. 2021. Better Representation is Needed in U.S. Endangered Species Act Implementation. Frontiers in Conservation Science 2: 650543. Doi: 10.3389/fcosc.2021.650543.

Mota, M., Sousa, R., Araujo, J., Braga, C. and Antunes, C. 2014. Ecology and conservation of freshwater fish: time to act for a more effective management. Ecology of Freshwater Fish: 23: 111-113.

National Drought Mitigation Center. 2023. Arizona Percent Area in U.S. Drought Monitor Categories. Available at: https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx (accessed February 2023).

National Park Service. 2022. Riparian Zones – It's all about the Water https://www.nps.gov/articles/000/nrca_glca_2021_riparian.htm (Accessed October 2022).

NatureServe. 1996a. Available at: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.105427/Tyrannus_melancholicus (accessed December 2022).

NatureServe. 1996b. Available at: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.101513/Polioptila_nigriceps (accessed December 2022).

NatureServe. 1996c. Available at: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.103989/Amphispizopsis_quinquestriata (accessed December 2022).

NOAA 2019. Fish Passage Solutions on the West Coast: Culverts, Tidegates, and Fish Screens. Last updated on 09/27/2019. Available at: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/fish-passage-solutions-west-coast-culverts-tidegates-and (accessed December 2022).

NOAA 2022. Arizona. NOAA National Centers for Environmental Information. State Climate Summaries 2022 150-AZ. Available at:

https://statesummaries.ncics.org/downloads/Arizona-StateClimateSummary2022.pdf (accessed November 2022).

Reese, A. 2019. Trump's Border Wall Could Cause Flooding in Texas. October 16, 2019. Scientific American. Available at: https://www.scientificamerican.com/article/trumps-border-wall-could-cause-flooding-in-texas/ (accessed December 2022).

Reznick, A. 2022. CBP moves forward with remediation plans along parts of Arizona border. Arizona Public Media, April 6, 2022. Available at: https://news.azpm.org/p/newsc/2022/4/6/208773-cbp-moves-forward-with-remediation-plans-along-parts-of-arizona-border/ (accessed December 2022).

Sky Island Alliance and Wildlands Network 2022. Customs and Border Protection Remediation Plan for the Tucson Sector. Key Messages for Public Comment. Available at: https://skyislandalliance.org/wp-content/uploads/2022/01/Tucson-Remediation-Plan-Comment-Talking-Points.pdf (accessed December 2022).

Stefferud, S.E. and Stefferud, J.A. 2007. Fish movement through intermittent stream channels. A case history study. Report to U.S. Bureau of Reclamation, Phoenix, AZ. August 13, 2007. Available at: https://www.usbr.gov/lc/phoenix/biology/azfish/pdf/intermittentStreams.pdf (accessed December 2022).

Traphagen, M. 2021. The Border Wall in Arizona and New Mexico- July 2021. 10.13140/RG.2.2.25669.32481.

University of Idaho 2010. WLF 448: Fish & Wildlife Population Ecology. Lab 11: Metapopulations. Fall 2010. Revised 15 November 2020. Available at: https://www.webpages.uidaho.edu/wlf448/2010/Lab/11LabNotes-Metapopulations2010.htm (accessed November 2022).

USFS 2019. Biological Assessment for Coronado National Forest Livestock Grazing Program. February 2019. Available at: https://pimanrcd.files.wordpress.com/2019/04/ba_cnf-grazing_022719_final.pdf (accessed December 2022).

USFS 2022. Nationwide Aerial Application of Fire Retardant on National Forest System Lands Draft Supplemental Environmental Impact Statement. Available at: https://www.fs.usda.gov/sites/default/files/2022-02/2022-Aerial-Fire-Retardant-DraftSEIS.pdf (accessed January 2023)

USFWS 1986. Endangered and Threatened Wildlife and Plants; Final Rule To Determine the Sonora Chub To Be a Threatened Species and To Determine Its Critical Habitat. Final Rule. Federal Register, Vol. 51, No. 83, Wednesday, April 30, 1986.

USFWS 1992a. Sonora chub recovery plan. Phoenix, Arizona. October 1992.

USFWS 1992b. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Northern Spotted Owl. Final Rule. Federal Register, Vol. 57, No. 10, Wednesday, January 15, 1992.

USFWS 2009. Owens Tui Chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*). 5-Year Review: Summary and Evaluation. May 19, 2009.

USFWS 2011. Biological Opinion. Effects to Listed Species from U.S. Forest Service Aerial Application of Fire Retardants on National Forest System Lands. December 6, 2011. Available at: https://www.fs.usda.gov/sites/default/files/media_wysiwyg/fws_afr_bo_firsthalf.pdf (accessed October 2022).

USFWS 2013. Sonora chub/Charalito Sonorense (*Gila ditaenia*) 5-Year Review: Summary and Evaluation. August 2013.

USFWS 2014. Endangered and Threatened Wildlife and Plants; 12-Month Finding on the Petition To List Least Chub as an Endangered or Threatened Species; Proposed Rule. Federal Register, Vol. 79, No. 165, Tuesday, August 26, 2014.

USFWS 2015. Biological and Conference Opinion, FWS/R2/ARD-ES/059502, Consultation #02E00000-2015-F-0001 (Natural Resources Conservation Services' (NRCS) Working Lands for Wildlife Project). February 13, 2015. Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd333895&ext=pdf (accessed October 2022).

USFWS 2017a. Biological Opinion Conference Opinion for Coronado National Forest Land and Resource Management Plan. Cochise, Graham, Pima, Pinal, and Santa Cruz Counties, Arizona and Hidalgo County, New Mexico. Southwestern Region U.S.D.A. Forest Service [April 13, 2017].

USFWS 2017b. Critical Habitat. *What is it?* March 2017. Available at: https://www.fws.gov/sites/default/files/documents/critical-habitat-fact-sheet.pdf (accessed December 2022).

USFWS. 2018. Species status assessment report for the Arkansas River shiner (*Notropis girardi*) and peppered chub (*Macrhybopsis tetranema*), version 1.0, with appendices. October 2018. Albuquerque, NM. 172 pp.

USFWS 2019. Supplemental Finding for Sonora Chub Recovery Plan. June 2019.

USFWS 2021a. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Northern Spotted Owl. Federal Register, Vol. 86, No. 215.

USFWS 2021b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo. Final Rule. Federal Register, Vol. 86, No. 75, Wednesday, April 21, 2021.

USFWS 2022a. Sonora Chub/Charalito Sonorense (*Gila ditaenia*) 5-Year Review: Summary and Evaluation. Phoenix, Arizona. August 2022.

USFWS 2022b. 90-day finding on a petition to revise Sonora chub (*Gila ditaenia*) critical habitat [90-day finding review form, revision of critical habitat). Federal Docket No. FWS-R2-ES-2022-0012.

USFWS 2022c. ESA Section 7 Consultation. Available at: https://www.fws.gov/service/esa-section-7-consultation (accessed October 2022)

USFWS 2022d. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Peppered Chub and Designation of Critical Habitat. Federal Register, Vol. 87, No. 39, Monday, February 28, 2022.

Wildlands Network. 2021. CBP Border Barrier Remediation Plan Map by Wildlands Network–Tucson Sector-Pima County, Santa Cruz County, and Cochise County- January 2022. Published August 2021. Updated November 2022. Available at: https://www.google.com/maps/d/viewer?ll=31.39012132444439%2C-111.24616276147461&z=14&mid=1PNwPSwo1TdhnYlAKgcmu2SLmD4GiyiYN (accessed December 2022)