RECOVERY PLAN AMENDMENTS FOR ELEVEN SOUTHWEST SPECIES

The U.S. Fish and Wildlife Service identified best available information indicating the need to amend the below species' recovery criteria. Each amendment is recognized as an addendum that supplements the existing recovery plan.

Black Lace Cactus (*Echinocereus reichenbachii* var. *albertii*) Recovery Plan	
Original Recovery Plan Approved:	March 18, 1987
Page(s) Superseded:	24
Little Colorado Spinedace (*Lepidomeda vittata*) Recovery Plan	
Original Recovery Plan Approved:	January 9, 1998
Page(s) Superseded:	8
Loach Minnow (*Tiaroga cobitis*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	20-22
Masked Bobwhite (*Colinus virginianus ridgwayi*) Recovery Plan	
Original Recovery Plan Approved:	April 21, 1995
Page(s) Superseded:	37
Mexican Long-Nosed Bat (*Leptonycteris nivalis*) Recovery Plan	
Original Recovery Plan Approved:	September 8, 1994
Page(s) Superseded:	33-35
Navajo Sedge (*Carex specuicola*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 1987
Page(s) Superseded:	10
Nichol's Turk's Head Cactus (*Echinocactus horizonthalonius* var. *nicholii*) Recovery Plan	
Original Recovery Plan Approved:	April 14, 1986
Page(s) Superseded:	None
San Marcos & Comal Springs & Associated Aquatic Ecosystems (Revised) Recovery Plan	
Original Recovery Plan Approved:	February 14, 1996
Page(s) Superseded:	54-57
Species Included:	Texas wild-rice (*Zizania texana*) fountain darter (*Etheostoma fonticola*) Texas blind salamander (*Typhlomolge rathbuni*)

Sonora[n] Tiger Salamander (*Ambystoma tigrinum stebbinsi*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 2002
Page(s) Superseded:	13
Spikedace (*Meda fulgida*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	19-22
Texas Poppy Mallow (*Callirhoe scabriuscula*) Recovery Plan	
Original Recovery Plan Approved:	March 29, 1985
Page(s) Superseded:	11

For

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: DEC 0 6 2019

Little Colorado River Spinedace (*Lepidomeda vittata*) Recovery Plan
https://ecos.fws.gov/docs/recovery_plan/980109.pdf

Original Approved: January 9, 1998
Original Prepared by: The Parker Fisheries Resource Office, U.S. Fish and Wildlife Service and the Apache Trout/Little Colorado Spinedace Recovery Team, and Members of the Desert Fishes Recovery Team

AMENDMENT 1
We have identified best available information that indicates the need to amend recovery criteria for Little Colorado spinedace (*Lepidomeda vittata*) since we completed the Little Colorado River Spinedace Recovery Plan (Recovery Plan) in 1998. In this proposed modification, we synthesize the adequacy of the existing recovery criteria, show amended recovery criteria, and the rationale supporting the proposed recovery plan modification. The proposed modification is shown as an addendum that supplements the Recovery Plan, superseding only the Recovery Objectives/Criteria in the Executive Summary (page iv) and as summarized on page 8 of the Recovery Plan.

For
U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

BACKGROUND INFORMATION
Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if the significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time.

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats, or species' response to management. An amendment could serve a critical function while awaiting a revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

We looked at existing quantifiable recovery criteria for similar species in similar habitats to help develop delisting criteria for Little Colorado spinedace. We also analyzed the recovery actions that the U.S. Fish and Wildlife Service (USFWS) and our partners have taken since the development of the original Recovery Plan, and survey and habitat data provided by the Arizona Game and Fish Department (AGFD). We coordinated the development of this amendment with the AGFD. We will solicit peer review of this amendment concurrent with publication of a Notice of Availability for the draft amendment in the *Federal Register*.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (ESA) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list." Legal challenges to recovery plans (see Fund for Animals v. Babbitt, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) have also affirmed the need to frame recovery criteria in terms of threats assessed under the five threat factors (ESA 4(a)(1)).

Recovery Criteria

Recovery criteria for Little Colorado spinedace were only described in the Executive Summary of the Recovery Plan (page iv), as: secure and maintain all extant populations; establish refugia in the most natural identifiable habitats within the probable historic range; and, reintroduced populations will not be considered established until they have persisted for a minimum of five years. The Recovery section of the Recovery Plan itself only states that when the goals of the Recovery Plan are achieved, it will be possible to delist the species and that if the Recovery Plan requires revision of objectives and tasks as new data becomes available, recovery criteria will be modified as appropriate (page 8).

Synthesis

New information on Little Colorado spinedace that has become available since completion of the original Recovery Plan is largely summarized in the most recent 5-Year Status Reviews (USFWS 2008, 2018). What we have come to understand is that the Little Colorado spinedace is a fish with a limited, highly fragmented distribution and relatively low numbers, making it highly vulnerable to stressors, particularly drought, ground-water and surface water withdrawals, high-severity landscape-scale wildfires, and predation and competition with non-native warm water fishes. Uncertainties and data gaps that may impede recovery progress include climate change and the effects of extended drought and increased human water consumption on the persistence of spinedace habitat; the lack of knowledge regarding genetic diversity; and, inconsistent social

attitudes towards the use of piscicide to control invasive non-native fishes and other aquatic organisms.

Currently, the Little Colorado spinedace occurs in disjunct locations in three subbasins of the Little Colorado River (LCR) Basin: the Middle Little Colorado (Hydrologic Unit Code [HUC] 15020008), Chevelon Canyon (HUC 15020010), and Little Colorado Headwaters (HUC 15020001) (Figure 1, Table 1). Little Colorado spinedace may also still inhabit portions of the Little Colorado River in the Upper Little Colorado Subbasin (HUC 15020002), which begins downstream from the Little Colorado headwaters below the dam at Lyman Lake. However, recent trends toward reduced to intermittent flows associated with drought and upstream diversions, combined with the influence of nonnative fishes, have created increasingly unfavorable habitat conditions for spinedace downstream of Lyman Lake.

The AGFD surveyed fish at all known Little Colorado spinedace locations in 2018 except middle Chevelon Canyon (The Steps) and the Becker Wildlife Area. In addition, the AGFD and USFWS have translocated Little Colorado spinedace to all known suitable habitats in the East Clear Creek watershed except Miller Canyon (surveyed for suitable habitat in 2018 and tentatively slated for Little Colorado spinedace reintroduction in 2019) and General Springs Canyon (slated for nonnative fish removal in 2019). The population at Nutrioso Creek is vulnerable due to predation and competition from non-native fish, and habitat loss associated with water management practices, and thus is in need of immediate management. Control of non-native fishes in Nutrioso Creek should extend into the lower portion of its tributary, Rudd Creek. Reintroduction of Little Colorado spinedace to upper Rudd Creek (upstream from a series of barriers) will help secure a portion of the lineage in habitat that is currently inaccessible to nonnative fish from Nelson Reservoir. We have a poor understanding of the overall status of spinedace in Chevelon Creek due to a lack of recent monitoring surveys throughout the entire mainstem. There is a large and persistent population of Little Colorado Spinedace in lower Chevelon Creek centered on an area called "The Steps." This population continues to exhibit the highest densities of Little Colorado Spinedace compared to any other occupied site (100-150 spinedace per seine haul on average). Papadopoulos and Associates (2005) predicted that, based on current regional pumping, the base flow of Lower Chevelon Creek would be zero in 60 years. Currently, the most robust spinedace population left in Chevelon Creek and within designated critical habitat is located in the area expected to lose surface flow (the population centered on The Steps). Based on the precarious status of the spinedace in this area and current effects to its habitat, we consider any further reduction in flows significant. The lack of surface water in Chevelon Creek may reduce our ability to establish new viable populations in this watershed. Surveying spinedace in the creek is high priority to assess its current distribution and abundance and to identify management needs. The East Clear Creek lineage currently has the most redundancy (including three populations within the Willow Creek drainage), but requires continued habitat protection and additional reintroduction efforts to expand its distribution and improve its resiliency. The USFWS and AGFD identified stream reaches in Miller Canyon and General Springs Canyon as the most suitable sites for future reintroductions. There is more than 2 km (1.24 mi) of interrupted perennial stream habitat in Miller Canyon that is suitable for Little Colorado spinedace, which were historically present there. General Springs Canyon contains more perennial water than Miller Canyon, but mechanical removal of nonnative green sunfish (*Lepomis cyanellus*) from large pools in its middle reaches is necessary prior to stocking.

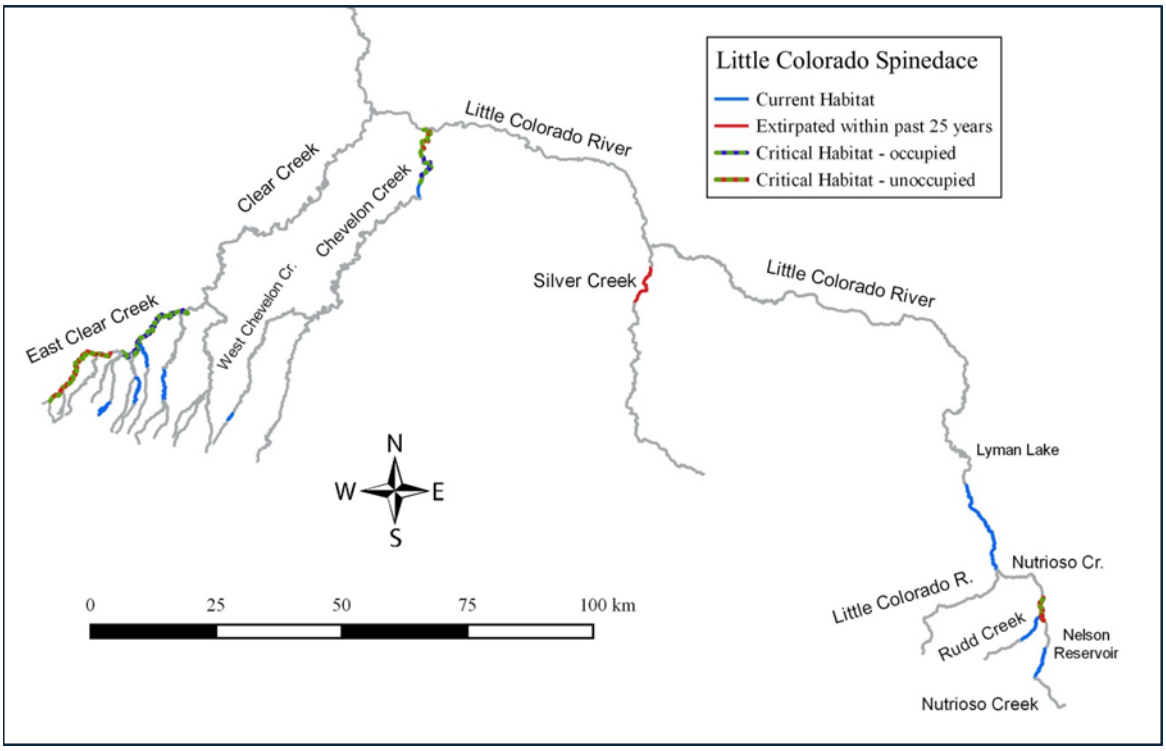

Figure 1. The current known distribution of Little Colorado spinedace, as well as designated critical habitat and stream reaches where populations are likely extirpated. There are historical records of Little Colorado spinedace in all streams shown.

Table 1. Locations and the total length of occupied stream habitat as of 2018 by Little Colorado Spinedace lineages (as identified by Tibbets *et al*. 2001).*

Lineage and Stream Habitats	Occupied Habitat (km)	Occupied Habitat (miles)	County	Most Recent Survey
East Clear Creek				
East Clear Cr. above CC Cragin Res.	0	0	Coconino	2011
East Clear Cr. below CC Cragin Res.	0	0	Coconino	2011
Dane Canyon	6.6	4.0	Coconino	2018
Bear Canyon	8.4	5.2	Coconino	2018
Leonard Canyon	4.4	2.7	Coconino	2018
West Leonard Canyon	5.9	3.7	Coconino	2018
Yeager Canyon	1.9	1.2	Coconino	2018
Chevelon Creek				
West Chevelon Creek	1.8	1.1	Coconino	2018
Chevelon Creek (The Steps)	8.1	5.0	Navajo	2009
Chevelon Creek (lower)	0	0	Navajo	2018
Little Colorado River				
Nutrioso Creek above Nelson Res.	18.1	11.2	Apache	2018
Nutrioso Creek below Nelson Res.	0	0	Apache	2018
Rudd Creek	6.2	3.8	Apache	2018
Little Colorado River (headwaters)	36.6	20.1	Apache	2018

*The Silver Creek population of Little Colorado spinedace is likely extirpated. The Arizona Game and Fish Department last conducted surveys in Silver Creek in 2009.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the species is no longer at risk of extinction and may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from an endangered species to a threatened species. The term "endangered species" means any species (species, sub-species, or DPS) which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species, which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting species must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely on the basis of the best scientific and commercial data available." Thus, while recovery plans provide important guidance to the USFWS, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when an analysis of the species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

We provide recovery criteria for the Little Colorado spinedace, which will supersede those included in the 1998 Recovery Plan, as follows:

Delisting Recovery Criteria

Little Colorado spinedace may be considered for delisting when the following criteria are met:

1. A minimum of five viable (self-sustaining) populations for each of the three lineages of Little Colorado spinedace (15 viable populations in total) are stable or increasing for five years beyond establishment. For us to consider the population established, the reintroduced population must persist for a minimum of five years (USFWS 1998) after the final stocking and exhibit juvenile recruitment (*e.g.*, multiple age-classes). Once a population has been established, monitoring will be conducted for an additional five years to evaluate and confirm continued persistence.

   Due to climate change and groundwater withdrawals, perennial habitat suitable for spinedace is likely to become increasingly scarce; it is possible that the Chevelon Creek

watershed will not support five viable populations. Therefore, although the Recovery Plan does not address this situation, we may need to identify locations outside of this watershed, but within the overall range of the spinedace to establish viable populations of this lineage to ensure the lineage is replicated sufficiently. If we need to establish populations of the Chevelon Creek spinedace lineage outside of Chevelon Creek, we will identify habitats unlikely to connect to the other two lineages to maintain the genetic uniqueness of the lineages. Any populations of the Chevelon Creek spinedace lineage that become established outside of the Chevelon Creek watershed will improve the redundancy of the source population and serve as sources for reintroduction of individuals to historically occupied habitats within the watershed should the opportunity arise.

Justification: We chose five viable populations because given the trends in habitat availability and quality; it will likely ensure species viability. Achieving this criterion may require reintroductions, and significant stressor and habitat management due to long-term drought and water depletion associated with climate change. There are currently three viable populations of the East Clear Creek lineage (West Leonard/Leonard Canyon, Bear Canyon, and Dane Canyon); a large, persistent population in Chevelon Canyon (centered around, but not restricted to "The Steps"); and two to three viable populations in the LCR (Table 1).

For the monitoring timeframe, five years is appropriate because it allows for stochastic events, multiple spawning seasons and monitoring to document juvenile recruitment. Little Colorado spinedace are short-lived fish, and a population is unlikely to persist for more than five years in the absence of juvenile recruitment or augmentation (USFWS 1998). In addition, based on past spinedace establishment efforts, reintroduced populations that maintain themselves for at least five years are likely to demonstrate long-term persistence (*e.g.*, Yeager Canyon, which AGFD and USFWS originally stocked spinedace into in 2007 and they continue to persist to date).

A viable population is self-supporting with sufficient numbers and genetic variety among healthy individuals and sufficiently distributed breeding fishes to ensure a high probability of survival despite the foreseeable effects of demographic and stochastic events. These fish should occur in locations with habitat features necessary to meet all of the ecological requirements of the species. A viable population must exhibit juvenile recruitment (*e.g.*, multiple age-classes) during one or more monitoring surveys conducted during the previous five years.

A lineage is a population or group of populations of spinedace within a specific watershed in which connections between occupied habitats were historically present and all current populations are genetically more similar to one another than to populations in other watersheds. There are currently three different lineages (as described by Tibbets *et al*. 2001) identifiable by geographic area (East Clear Creek drainage, Chevelon Creek, and the upper LCR, which includes Nutrioso and Rudd creeks).

A reintroduced population is a group of translocated individuals and their progeny that are established in natural habitat at a location within historic range. After establishment, additional stockings may be necessary to maintain genetic diversity due to reduced or extended connectivity issues (*e.g.*, extended drought).

2. Maintain a minimum of five core recovery areas that support at least 15 viable populations within the Clear Creek, Chevelon Canyon, and LCR watersheds. A core recovery area is a stream reach (identified by National Hydrography Dataset [NHD]) that contains habitat, including associated intermittent or perennial lotic habitat, that provides for all of the life-history needs of the species. These areas must show resistance to long-term drought and climate change and be free of warm water non-natives fishes that predate upon and compete with Little Colorado spinedace (*e.g.*, green sunfish and smallmouth bass [*Micropterus dolomieu*]). Protecting existing populations of Little Colorado spinedace will require maintaining core recovery areas through habitat protection and any necessary restoration or enhancement efforts, combined with removal of any non-native fishes that pose a threat to Little Colorado spinedace.

   Justification: Core recovery include a series of seasonally or permanently interconnected perennial pools that maintain depths sufficient to support spinedace on a year-round basis and serve as essential refugia during dry periods and winter. The habitats spinedace occur in fluctuate in dimensions throughout the watersheds in which they occur. Therefore, we should use watershed-specific monitoring to inform the minimum water depth, surface area, length and width of a particular core habitat.

3. Establish at least one refugia for each of the Little Colorado spinedace lineages. Each refugia must have a genetic management plan. Establish refugia in the most natural identifiable habitats within the probable historic range.

   Justification: A refugia is a site with an artificial environment or a modified off-channel habitat in which we maintain Little Colorado spinedace as broodstock and/or to contribute to the preservation of the genetic diversity of a specific lineage. We consider Little Colorado spinedace to be a moderately conservation reliant species (Rohlf *et al*. 2014). Because the Little Colorado spinedace is a fish with a limited, highly fragmented distribution and habitat, making it highly vulnerable to stressors (*i.e.*, drought, ground water and surface water withdrawals) we expect that it may need some direct and ongoing management in order to persist indefinitely in the wild. Refugia have been instrumental in providing locations where spinedace salvaged due to drought or fire can be held temporarily, and then restocked when habitat conditions recover. The establishment and management of refugia will also ensure that redundancy is sufficient to address the uncertainty associated with water availability in the future.

Rationale for Amended Recovery Criteria

Developing quantifiable criteria for the recovery of Little Colorado spinedace is difficult because of the highly variable lotic environments they occur in and due to their fragmented distribution, which is a result of historic water and land management practices. The incorporation of the amended recovery criteria into the recovery plan is appropriate because it allows us to quantify

and measure our progress towards recovery. In addition, the amended criteria meet the intent of the recovery criteria in the Recovery Plan and reflect the recovery strategy and conservation measures for the Little Colorado spinedace. The amended criteria will ensure that we address and mitigate the underlying causes of decline (insufficient viable populations and nonnative fish) by providing a measurable path to recovery. The achievement of the amended criteria would result in the Little Colorado spinedace no longer meeting the definition of a threatened species by increasing the resiliency, representation, and redundancy of the fish throughout its range.

The USFWS uses the concepts of resilience, redundancy, and representation ("3Rs") to identify the conditions needed for species viability. Below, we discuss the relevance of the 3Rs, which when combined with the explanation above, provide for a complete rationale for the criteria.

Resilience refers to the population size necessary to endure stochastic events such as random fluctuations in spawning rates (demographic stochasticity), variations in climate and weather (environmental stochasticity), or the effects of anthropogenic activities. We know little about the population numbers needed to achieve resiliency for Little Colorado spinedace, however, in general having more viable populations will provide greater resiliency. Having multiple viable populations within and across the three current and historically occupied watersheds will increase resilience of the species.

Redundancy is the ability of a species to withstand catastrophic events. Species that occur in multiple sites distributed broadly across the species' range have redundancy. Because the three watersheds containing the three lineages of Little Colorado spinedace are geographically or ecologically independent, by maintaining viable populations within multiple sites within these three watersheds, spinedace are less likely to be simultaneously affected by catastrophic events, such as high-severity wildfire effects. Therefore, the species is more likely to withstand these events. However, the absence of water is a limiting factor for spinedace as well as the presence of non-native fish where water does occur, so threat abatement must occur throughout the range of the species. The establishment and management of refugia will ensure that redundancy is sufficient to address the uncertainty associated with water availability in the future.

Representation is the ability of a species to adapt to changing environmental conditions. A species can achieve representation by maintaining the numbers and geographic distribution of a species throughout its historical range. We have limited genetic information regarding Little Colorado spinedace, but the data we do have (Tibbets *et al*. 2001) suggests a lack of genetic diversity and gene flow. However, conserving geographically distinct groups within and between watersheds should conserve the breadth of the genetic makeup of the species to conserve its adaptive capabilities.

The delisting criteria will assist in evaluating whether threats that caused the Little Colorado spinedace to be a threatened species are still affecting the species. Currently, threats related to Factor A (Present or threatened destruction, modification or curtailment of the species habitat or range), Factor C (Disease or predation), and Factor E (Other natural or manmade actors) are affecting the species' continued existence as described above and in Five-Year Status Reviews (USFWS 2008, 2018). Past land and water management that reduced surface water flow and fragmented habitat (Factor A); nonnative, predatory fish (Factor C); and, drought and climate

change, which reduce surface water needed to support spinedace will continue to affect Little Colorado spinedace habitat. However, work by the AGFD, the USFWS, and other partners (U.S. Forest Service, Bureau of Reclamation, Bureau of Land Management, Jim Crosswhite, and others) to improve habitat condition, remove nonnative fish, and find new locations for spinedace is making incremental progress toward improving the status of the species (USFWS 2018). Extended drought due to climate change and our inability to fully control nonnative fish are significant impediments to recovery and result in doubt as to the persistence of spinedace habitat into the future. Despite this uncertainty, maintaining as many sites as possible in different geographic and hydrologic settings throughout the range of Little Colorado spinedace is an appropriate strategy for safeguarding the species' ability to withstand the continued effects of these threats.

ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS

Not applicable.

COSTS, TIMING, PRIORITY OF ADDITIONAL RECOVERY ACTIONS

Not applicable.

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APPENDIX A – SUMMARY OF PUBLIC, PARTNER, AND PEER REVIEW COMMENTS RECEIVED

Summary of Public Comments

We published a notice of availability in the *Federal Register* on August 6, 2019 (84 FR 38288-38291) to announce that the draft amendment for the Little Colorado spinedace (*Lepidomeda vittata*) Recovery Plan (Recovery Plan) was available for public review, and to solicit comments by the scientific community, State and Federal agencies, Tribal governments, and other interested parties on the general information base, assumptions, and conclusions presented in the draft amendment. We posted an electronic version of the draft recovery plan amendment was on the Service's Little Colorado spinedace Species Profile website.

We did not receive any responses to the request for public comments.

Summary of Peer and Partner Review Comments

In accordance with the requirements of the Act, we solicited independent peer review of the draft amendment from qualified representatives from the following: Arizona Game and Fish Department and scientists and managers familiar with the Little Colorado spinedace. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to Little Colorado spinedace. The qualifications of the peer reviewers are in the decision file and the administrative record for this Recovery Plan amendment.

In total, we solicited review and comment from four peer reviewers/partner agencies. We received comments from three peer reviewers.

Peer reviewers that responded included representatives from Arizona Game and Fish Department and a retired Federal scientist with extensive knowledge of Little Colorado spinedace. In general, the draft amendment was well-received by the peer and partner reviewers, garnering both positive comments and constructive criticism.

We considered all substantive comments, and to the extent appropriate, we incorporated the applicable information or suggested changes into the final Recovery Plan amendment. Below, we provide a summary of specific comments received from peer and partner reviewers with our responses; however, we addressed many of the reviewers' specific critiques and incorporated their suggestions as changes to the final amendment. Such comments did not warrant an explicit response, and as such, we did not address them here. We appreciate the input from all commenters, which helped us to consider and incorporate the best available scientific and commercial information during development and approval of the final Recovery Plan amendment.

Peer Review Comment (1): A peer reviewer suggested that we should base the persistence of each population on a 10-year time period developed by the International Union for the Conservation of Nature (IUCN 2017) versus the five-year period in the amended delisting criteria.

Response: The Recovery Plan (USFWS 1998) states that spinedace populations are not considered established until they have persisted for five years. Because the Little Colorado spinedace is a short-lived (three years), fast maturing species, we clarified in the final amendment that for us to consider a population established, the reintroduced population must persist (stable or increasing) for a minimum of five years (USFWS 1998). Once a population has been established, monitoring will be conducted for an additional five years to evaluate and confirm continued persistence. Collectively, this equates to minimum of ten years of monitoring consistent with the IUCN guidelines.

Peer Review Comment (2): A peer reviewer questioned why refugia would be required for delisting and recommended removing this criterion from the delisting criteria.

Response: We consider Little Colorado spinedace to be a moderately conservation reliant species (Rohlf *et al.* 2014). Because the Little Colorado spinedace is a fish with a limited, highly fragmented distribution and habitat, making it highly vulnerable to stressors (*i.e.*, drought, ground water and surface water withdrawals) we expect that it may need some direct and ongoing management in order to persist indefinitely in the wild. Refugia have been instrumental in providing locations where spinedace salvaged due to drought or fire can be held temporarily, and then restocked when habitat conditions recover. The establishment and management of refugia will also ensure that redundancy is sufficient to address the uncertainty associated with water availability in the future.

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