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Page(s) Superseded:	24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Page(s) Superseded:	8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Page(s) Superseded:	20-22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Page(s) Superseded:	37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Page(s) Superseded:	33-35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Page(s) Superseded:	10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Page(s) Superseded:	None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Page(s) Superseded:	54-57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Page(s) Superseded:	13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Page(s) Superseded:	19-22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Page(s) Superseded:	11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

Recovery Plan for Loach Minnow (*Tiaroga cobitis*)
https://ecos.fws.gov/docs/recovery_plan/910930f.pdf

Original Approved: September 30, 1991
Original Prepared by: Paul C. Marsh (Arizona State University, Tempe, Arizona)

AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for loach minnow (*Tiaroga cobitis*) since the recovery plan was completed in 1991. 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 step 6, pages 20, 21, and 22 of the recovery plan (Marsh 1991).

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 scientific and commercial information available. 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 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, therefore, 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

The original Loach Minnow Recovery Plan (Recovery Plan) was completed in 1991. Since that time, we have gained new information on the species through research and monitoring including updates on species locations, population status, and genetic variation.

A group of individuals knowledgeable in management of loach minnow meets annually to discuss progress in recovery efforts, new threats, and results of research. This management team consists of representatives from the Arizona Game and Fish Department (AGFD), New Mexico Department of Game and Fish, the U.S. Forest Service, U.S. Bureau of Land Management, U.S. Bureau of Reclamation, Service, and the White Mountain Apache Tribe. The management team agreed that the existing Recovery Plan is in need of revision. The Region 2 Regional Office of the Service appointed appropriate members to the Spikedace (*Meda fulgida*) and Loach Minnow Recovery Team (Recovery Team). The Technical Subcommittee of the Recovery Team has completed preliminary revisions to the 1991 Recovery Plan, including revisions to step 6, which addresses reintroduction of populations to selected streams within the species' historical range.

In the interim of finalizing a revised Recovery Plan, we recognize the need to establish quantitative recovery criteria for loach minnow. In this amendment, we identify recovery units (RUs) and provide downlisting and delisting criteria that have been vetted through the extant Recovery Team as a component of the larger Recovery Plan revision. Peer review of this amendment will be solicited concurrent with publication of a Notice of Availability for the draft amendment in the Federal Register. The full revised Recovery Plan will continue to be developed and will be submitted for peer review prior to finalization.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) 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) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five factors (ESA 4(a)(1)).

Recovery Criteria

Recovery criteria were not established in the current Recovery Plan based on an absence of information needed to identify criteria for delisting. Instead, the current Recovery Plan provides an objective and identifies steps considered necessary for delisting the species (pages 9 through 27).

Synthesis
New information on loach minnow gained through research, monitoring, and studies includes the following, some of which is summarized in the Federal Register document reclassifying loach minnow to endangered status (77 FR 10810; USFWS 2012), and some of which has been published subsequent to the Federal Register document. Ongoing monitoring occurs at almost all occupied sites, and annual reports are available for those efforts:

1) Annual monitoring at Blue River, Aravaipa Creek, and Eagle Creek in Arizona and at the Gila River, Gila Forks area, San Francisco River, and Tularosa River in New Mexico documents trends in population status (Robinson and Love-Chezem 2016, NMDGF 2017, Freeport-McMoRan 2018, NMDGF 2018, P. Reinthal, University of Arizona, pers. comm. 2018).
2) Monitoring has detected loach minnow in new locations including North Fork East Fork Black River and its tributaries; Dry Blue Creek, Frieborn Creek, Pace Creek, Mangas Creek, and Bear Creek, as summarized in Table 6 of the Federal Register (77 FR 10810) and including Schiffmiller 2007.
3) Research on geographic patterns of genetic variation (Tibbetts 1993, Tibbets and Dowling 1996) indicates that gene flow has been low but not historically absent, and that each remaining population is genetically distinct. Additional research assessed relatedness of loach minnow in the Gila Forks area and the mainstream Gila River, determining that the populations are still genetically connected (Pilger et al. 2015). Pilger et al. 2017 researched patterns of genetic variation in the Upper Gila River.
4) Additional research has been completed on the impacts of predation by and competition with nonnative fishes, as summarized in 77 FR 10810 (USFWS 2012). (Propst 2002, Bonar et al. 2004, Rinne et al. 2004, Olden and Poff 2005, Propst et al. 2008, Olden et al. 2006, Pilger et al. 2010, Whitney et al. 2014).
5) Additional monitoring document the presence of nonnative fishes in systems occupied by loach minnow (Springer 1995, Jakle 1995, Propst et al. 2009, ASU 1994, ASU 1995, Clarkson et al. 2008, Paroz et al. 2009, Propst et al. 2009, Marsh et al. 2003, ASU 2008, Bahm and Robinson 2009, Robinson and Love-Chezem 2016).
6) Assessment of the impacts of wildfire on loach minnow in the Blue River, Arizona, and Gila River, New Mexico (Adelsberger 2011, H. Blasius, pers. comm. 2011, Patterson et al. 2012, Whitney et al. 2015a, Whitney et al. 2015b, Gido et al. 2019).
7) The ability to repatriate loach minnow in new areas (Blasius and Conn 2015, Love-Chezem and Robinson 2015, Love-Chezem et al. 2016, M. Ruhl, pers. comm. 2017).
8) Completion of nonnative fish barrier construction at Aravaipa Creek, Hot Springs Canyon, Bonita Creek, Blue River, and West Fork Black River to protect habitat occupied by or for repatriation efforts of loach minnow.
9) The ability to renovate streams by removal of nonnatives (Propst et al. 2014, Robinson and Love-Chezem 2016, Robinson et al. 2017, H. Blasius, pers. comm. 2018).
10) The effects of flow regimes altered over the long-term on native and nonnative fishes in the southwest (Gido et al. 2013).
11) The responses of fishes to climate change (Whitney et al. 2015a, Whitney et al. 2017).

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 a 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 Service, 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 we would anticipate that 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, which triggers rulemaking. 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 identify recovery units and establish both downlisting and delisting criteria for the loach minnow. The RUs are derived from the historical distribution of loach minnow, as well as the locations of existing remnant populations. The downlisting and delisting criteria will supersede Step 6 included in the 1991 Recovery Plan, as follows:

RU 1 – Verde River/Lower Salt River
RU 2 – Upper Salt River
RU 3 – San Pedro River/Lower Gila River
RU 4 – San Francisco River/Middle Gila River
RU 5 – Upper Gila River

Downlisting Recovery Criteria

1. Remnant Populations (Table 1, column 2). Maintain all 9 remnant populations of loach minnow in the wild such that they are self-sustaining, as evidenced by persistence and recruitment over the most recent 10-year period. Should remnant populations be determined extirpated, re-establish populations with appropriate genetic lineages (as determined through a genetics management plan), following repatriation guidelines described in Downlisting Criterion 3 below.

Justification: Remnant populations are the genetically distinct, wild populations of loach minnow remaining within the species' historical range (Tibbets 1992, Tibbets and Dowling 1996). Maintenance of the 9 remnant loach minnow populations ensures the preservation of genetic lineages and thus the preservation of species representation across its range.

2. Refugia Populations (Table 1, column 4). Establish refugia populations for each distinct genetic lineage. Refugia populations are those currently in captivity at the ARCC facility near Cornville, Arizona. One refugia population per recovery unit may be used to meet downlisting criteria. Because the recovery objective is to have the species persist without continual human management intervention, we are limiting the number of refugia populations to only one per recovery unit.

3. Replicate additional populations of loach minnow into new, unoccupied areas of each respective RU (Table 1, column 6). Repatriation of loach minnow into new locations may require eradiation or suppression of nonnative species to eliminate competition and predation. Within each RU, the combination of remnant, refugia, and replicate populations must be three or more. For wild populations, conduct annual monitoring to determine species are self-sustaining, as shown by persistence and recruitment, for five consecutive years following the last stocking effort at each site.

Justification: Replicates are populations of loach minnow that have been repatriated to unoccupied and isolated streams, and are representative of the genetically distinct remnant populations. The Recovery Team recommends two replications within RUs where there are existing remnant loach minnow populations, so that a total of three populations is achieved. The need for three loach minnow populations in each RU prior to downlisting is based on reasoning that if one of the three RU populations is extirpated, there would still be two self-sustaining populations in that RU. The three populations may include one refugia population per RU. These replicate populations of loach minnow will increase the species redundancy within a given RU, as well as increase species representation in portions of its historical range. Increased redundancy and representation will ensure that the species as a whole is able to withstand large-scale catastrophic events such as wildfire and prolonged drought, as well as smaller, local perturbations such as a nonnative fish invasion and water loss, all of which have been identified as primary threats to the loach minnow.

Table 1. Existing number of remnant populations within each recovery unit, and the total number of populations needed to reach downlisting goals. Refugia populations(column 4) will only count towards downlisting goals. Additional populations needed for delisting are subsequent to those needed for downlisting. (NOTE: ARCC = Aquatic Research and Conservation Center). (NOTE: ARCC = Aquatic Research and Conservation Center).

Recovery Unit	Remnant Populations	Replicate Populations	Refugia Populations (for Downlisting Only)	Total Number of Existing Populations	Additional Populations Needed for Downlisting	Additional Populations Needed for Delisting
RU1 – Verde/Lower Salt	None	None	None	0	3	1
RU2 – Upper Salt	1) White River					

Recovery Unit	Remnant Populations	Replicate Populations	Refugia Populations (for Downlisting Only)	Total Number of Existing Populations	Additional Populations Needed for Downlisting	Additional Populations Needed for Delisting
	2) North Fork East Fork Black River	None	None	2	1	1
RU3 – San Pedro/Lower Gila	1) Aravaipa Creek	1) Hot Springs Canyon	ARCC	3	0	2
RU4 –San Francisco/Middle Gila	1) San Francisco River + tributaries 2) Blue River 3) Eagle Creek	None	ARCC	4	0	1
RU5 – Upper Gila	1) Gila River 2) Mangas Creek 3) Bear Creek	None	ARCC	4	0	1
TOTALS	9	1	3	13	7	6

Delisting Recovery Criteria

In addition to meeting the downlisting criteria above, the, the loach minnow will be considered for delisting when:

1. All remnant (Table 1, column 2) and replicate (Table 1, column 3) populations of loach minnow are maintained in the wild as described above under Downlisting Criteria 1 and 3 such that they are self-sustaining, as evidenced by persistence and recruitment over the most recent 10-year period.

Justification: Self-sustaining populations are demonstrated by the fact that they persist and are reproducing. Persistence would be demonstrated by documenting fish, and recruitment would be demonstrated by presence of various size classes of fish.

2. Additional Replicate Populations. Replicate additional populations of loach minnow into new, unoccupied areas of each respective RU (Table 1, column 7). Conduct annual monitoring to determine species are becoming established, as shown by persistence and recruitment, for five consecutive years following the last stocking effort at each repatriation site. Replicates into new locations may first require habitat management actions to remove nonnative species that would compete with prey on loach minnow.

Justification: The Recovery Team suggests that one replication (in addition to those established under downlisting criteria) is appropriate in order to provide certainty that the species will persist moving forward. With existing remnant and repatriated replicate populations, should any one population be extirpated, sufficient other populations will remain to provide for resiliency, redundancy, and representation across the species historical range, thus ensuring remaining genetic diversity is maintained, and the species is less susceptible to stochastic widespread events. Should localized events extirpate a given location, sufficient fish will be present in other populations to prevent complete extirpation of any given genetic lineage. Because these species have a short life span (approximately 1 to 2 years in the wild), and can be difficult to capture and

to breed in captivity, sufficient population numbers are required to ensure that they can be repatriated.

Rationale for Amended Recovery Criteria

The primary objective of the 1991 Recovery Plan is stated as "…to identify steps and delineate mechanisms considered necessary to protect existing populations and restore depleted and extirpated populations of loach minnow and their habitats, and to ensure the species' non-endangered, self-sustenance in perpetuity." The 1991 Recovery Plan recognized that it would require modification as new information became available, noting that only after new information was discerned could quantitative criteria for delisting be elaborated. Interaction with non-native fishes and habitat modification, whether acting independently or in concert, are both considered contributory to decline and extirpation of loach minnow. The 1991 Recovery Plan recognizes the need to deal with both impacts in order to achieve recovery objectives.

A basic tenet of recovery planning in conservation biology is to ensure that recovery criteria address the biodiversity principles of representation, resiliency, and redundancy (Shaffer and Stein 2000). Representation concerns the protection of the breadth of genetic variability of a species by ensuring that populations occupy the full ecological gradient of a species' historical range to conserve its adaptive capabilities. Resiliency is the assurance that each population is sufficiently large to withstand most stochastic disturbance events, which usually is directly related to size of the habitat it occupies. Redundancy ensures there are a sufficient number of population replicates to guard against irreplaceable losses of representative populations from catastrophic events. Redford et al. (2011) articulated these concepts as "maintaining multiple populations across the range of the species in representative ecological settings, with replicate populations in each setting. These populations should be self-sustaining, healthy, and genetically robust - - and therefore resilient to climate and other environmental changes."

The amended criteria focus on improving redundancy, resiliency, and representation by reducing demographic threats to loach minnow. Overall, loach minnow are currently present in only 15 to 20 percent of their historical range. Remaining populations within that historical range are genetically distinct, as determined through genetic analyses (Tibbets, 1993, Tibbets and Dowling 1996). The amended criterion addresses representation both by maintaining genetic lineages and by increasing distribution across the historical range of the species. Hatchery populations will be developed for each genetic lineage to preserve genetic diversity until such time as ongoing threats are reduced or eliminated and a sufficient number of populations are established in the wild. Genetic lineages will not be mixed when establishing new populations. Should a genetic lineage from one watershed be used to establish a population in another watershed, the population would be developed only where they are isolated from other genetic lineages. (Additional, mixed lineages may be established outside of the recovery plan criteria once existing lineages are secure and with the guidance of a conservation geneticist.)

Finally, the criteria address redundancy by replicating each genetic lineage more than one time and in more than one location. Should an existing population succumb to threats at some time in the future, populations will have been established through downlisting and delisting criteria in each watershed, which will help to ensure viability.

The established criteria are overall very similar to steps identified as necessary in the 1991 Recovery Plan (Marsh 1991). Both the revised criteria and step 6 focus on repatriating loach minnow to additional streams outside those currently occupied. However, step 6 in the 1991 Recovery Plan failed to specify the needed number of repatriations needed to reach either downlisting or delisting. In addition, the 1991 Recovery Plan recommended choosing fish for repatriation efforts from "Stable, self-sustaining populations with capacity to contribute individuals…" as no genetic information was yet available to guide repatriation efforts. As currently amended, these criteria quantify the number of populations that would be needed to reach both downlisting and delisting goals. The revised criteria also rely on existing genetic information to replicate lineages in various RUs in order to improve representation and redundancy (Shaffer and Stein 2000).

The 1991 Recovery Plan noted that new information was necessary in order to identify quantitative information for delisting. In the intervening 27 years, additional information has been gained on species life history, distribution, genetics, and threats, as described in the Synthesis section above. The new quantitative criteria use the information gained to develop quantitative downlisting and delisting criteria that are measurable and objective, a need identified in the existing 1991 recovery plan. In addition, incorporation of amended criteria for downlisting and delisting into the recovery plan is appropriate, as it will add quantitative criteria that will lead to increased resiliency, redundancy, and representation for loach minnow.

The five listing factors are evaluated in the 2012 Federal Register notice reclassifying loach minnow to endangered status and designating critical habitat. The threats identified at the time the species was reclassified remain the same, with loss of habitat and competition with and predation by nonnatives considered to be the most significant. The 1991 Recovery Plan and the downlisting and delisting criteria above address these threats as follows:

Factor C – Disease or Predation. Step 1 of the 1991 Recovery Plan recommends curtailing transport and introduction of nonnative fishes, discouraging the use of live bait, examining the efficacy of barrier construction to protect against nonnative invasions and subsequent predation. Step 3 recommends research to determine the nature and significance of nonnative fish interactions, which would further inform management actions that would preclude predation. Step 6 requires assessing the status of nonnative fishes in watersheds, ensuring closure of immigration routes to preclude reinvasion by nonnatives, and removing nonnative fishes as necessary to reclaim streams for loach minnow recovery. Modified downlisting and delisting criteria 1 above require monitoring for the life of the recovery plan to ensure threats to remnant and newly repatriated populations are identified and addressed in a timely fashion.

Factor E – Other Natural and Manmade Factors Affecting the Species' Continued Existence. Step 1 in the 1991 Recovery Plan addresses this factor by requiring protection of existing loach minnow populations by discouraging detrimental land and water use practices, insuring perennial flows with natural hydrographs, curtailing transport of and introduction of nonnative fishes. Steps 3 and 4 require additional research on nonnative fish interactions and habitat needs to better inform management decisions. Step 6 requires assessing status of nonnative fishes in the watershed, assuring closure of immigration routes for nonnatives, and reclaiming streams as necessary for loach minnow recovery. Modified downlisting and delisting criteria above

requires replicating loach minnow into streams, which in turn will require removal of nonnative aquatic species in some instances. The downlisting and delisting criteria also require monitoring to ensure threats to remnant and newly repatriated populations, including invasion by nonnative aquatic species, are identified and addressed in a timely manner.

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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 loach minnow (Tiaroga cobitis) 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. An electronic version of the draft recovery plan amendment was also posted on the Service's Species Profile website (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6922).

The Service received three responses to the request for public comments. These included comments from the Center for Biological Diversity, the Arizona Game and Fish Department, and the U.S. Forest Service.

Public comments ranged from providing minor editorial suggestions to specific recommendations on the amendment content. We have considered all substantive comments; we thank the reviewers for these comments. Below, we provide a summary of public comments received; however, some of the comments that we incorporated as changes into the revised recovery plan did not warrant an explicit response and, thus, are not presented here.

Comment (1): The commenters stated that threats such as predation and competition need to be addressed and clarified in the Recovery Plan, and that the Recovery Plan should include information regarding suitable habitat, based on the Primary Constituent Elements identified for loach minnow

Response: The scope of a recovery plan amendment is strictly limited to the rewrite of a very specific section, supplementing that section but not completely replacing the existing recovery plan. This Recovery Plan amendment focuses on the establishment of quantitative criteria for what constitutes a recovered species, and we are only supplementing the existing Recovery Plan with new information on two recovery criteria. A full Recovery Plan revision is underway for loach minnow, and is the appropriate process for updating all other Recovery Plan content, such as species background information, threats, the recovery strategy, goals and objectives, site-specific recovery actions, the estimated time and cost of recovery, and the implementation schedule.

Comment (2): The commenter stated that it appears that remnant and reintroduced populations have been combined for species in Table 1. Remnant populations need to be separated out due to their unique genetic lineage.

Response: We have modified Table to identify the numbers of remnant, refugia, and recovery populations needed by recovery unit.

Comment (3): The commenter stated that there should be no viable remnant population in the Verde/Lower Salt Recovery Unit as loach minnow have not been detected in many years. Loach

minnow have not been detected for over a decade at the Three Forks or Eagle Creek areas. Similarly, the North Fork East Fork Black population was last detected in 2005 and the Bear Creek population was last detected in 2007.

Response: The Recovery Team is in the process of finalizing definitions and criteria that will be used to determine when a given population will be considered extirpated. Genetic assessments are underway which will also be used in determining populations in the final recovery plan revision. In the interim, additional monitoring is ongoing, using both traditional techniques (seining and electroshocking) and eDNA collection. We anticipate that, prior to finalization of the Recovery Plan revision, these definitions and the most recent monitoring information will be used to reach a final determination of occupied or extirpated, as appropriate, for streams such as the Verde River and Eagle Creek. It should also be noted that loach minnow have been detected in Bear Creek as recently as 2018 and in the Gila Forks area in 2018.

Comment (4): The commenter asked for clarification on what determines if replicate populations are viable.

Response: For wild populations, we will conduct annual monitoring to determine that the population is self-sustaining, as shown by persistence and recruitment, for five consecutive years following the last stocking effort at each site. The Recovery Team will also be developing guidance on how large a population should be to be considered viable or self-sustaining.

Comment (5): Two commenters noted concerns with definitions or descriptions of persistence, reproduction, recruitment, and population size indices as being not objective, measureable or reasonable.

Response: We anticipate that the size of a population determined to be self-sustaining will vary depending on the repatriation stream; however, as noted in the criteria, a self-sustaining population would show evidence of both persistence and recruitment. This also applies to remnant populations. Genetic analyses and a genetic management plan are underway which will help in determining effective population size as well as key factors to use in assessing genetic diversity within and across populations (including captive stock and repatriated populations). In response to these comments, we have revised language in the final recovery plan revision to clarify the application of these terms.

Comment (6): The commenter stated that the downlisting criteria seem more rigorous than the delisting criteria. The definition/criteria for replicate populations in the recovery plan is more rigorous than the proposed criteria. The Recovery Plan at least outlines identifying amendable stocks for reintroduction (genetics, assessment of habitat, and determining success/failure). The proposed criteria only discusses nonnative removal as something that may have to happen.

Response: The delisting criteria within this Recovery Plan amendment build on the downlisting criteria. In order to delist loach minnow, all down- and delisting criteria will therefore have to be met. Please see the response to *Comment* (1) above. The Recovery Team will develop additional detail within the revised Recovery Plan.

Comment (7): Two commenters stated that the definition of "replicate" does not address what it is spatially, and that we should provide some type of parameters that describe site or geographic range, viability, and/or connectivity between sites to help in defining "population". The commenters asked if stocking in a tributary to an occupied stream become a replicate or is it a range expansion since there would be no downstream barriers to movement.

Response: Stocking in a tributary to an occupied stream becomes a range expansion, unless there is a barrier to genetic exchange (such as an extensive ephemeral reach). In response to these comments, we have clarified in the final Recovery Plan amendment that replicates are populations of loach minnow that have been repatriated to unoccupied and isolated streams, and have reorganized Table 1 to better identify tributary streams within each recovery unit.

Comment (8): The commenter stated that it would be helpful to describe why the total number of populations needed varies between recovery units. This could be further strengthened by defining some measure of the occupied habitat (miles, site occupancy, etc.).

Response: The total number of populations varies between recovery units because there are varying numbers of extant populations in recovery units. For downlisting, for example, the combination of remnant, refugia, and replicate populations must be three or more. If there are no extant populations, then three are needed. However, if there are two extant populations, only one is needed to reach the downlisting criteria.

Comment (9): The commenter stated that the term "refugia population" needs to be better defined. In addition, keeping refugia populations until such time as not needed inherently means we are taking from wild populations constantly to maintain the hatchery. What does that mean for wild populations?

Response: We have provided clarification in the final Recovery Plan amendment that refugia populations are those currently at the ARCC facility near Cornville, Arizona. We are using captive stock for repatriation efforts in Arizona, and for some of the recovery work in New Mexico. Development of hatchery broodstock allows us to remove smaller numbers of fish from the wild and then produce larger numbers of offspring for repatriation efforts, rather than removing larger numbers of fish for repatriation efforts. The goal is to establish a sufficient number of loach minnow populations over a larger percentage of their historical range, and refugia populations will be used to ensure that genetic lineages are not lost during recovery efforts, as well as to reach downlisting goals. Refugia populations may be kept until delisting is achieved; however, refugia populations will not be used to meet delisting criteria. Ultimately, when delisting criteria are met and the species is recovered, we will discontinue use of refugia populations.

Comment (10): The commenter asked if the recommendations from geneticists are not to stock out hatchery populations back to the wild populations, what is their fate and how do we protect/maintain wild populations other than monitoring them?

Response: Please see the response to *Comment* (1) above. The Recovery Team is developing additional threats-based criteria in the revised Recovery Plan that will address protection of wild

populations. We anticipate that refugia populations will ultimately be discontinued, once we have repatriated loach minnow to new locations within their historical range.

Comment (11): The commenter stated that they are opposed to removing Eagle Creek, Bonita Creek, and the San Pedro River as reintroduction areas for loach minnow.

Response: We are not precluding Eagle Creek, Bonita Creek, or the San Pedro as reintroduction sites for loach minnow in the future. The Recovery Team is still evaluating specific streams for future repatriation efforts, as part of the recovery actions in the revised Recovery Plan under development. However, we note that, to date, efforts at establishing loach minnow at Bonita Creek have failed, and that there are nonnative aquatic species issues within San Pedro that would need to be resolved.

Comment (12): The commenter stated that the draft amendment would set a goal of zero new so-called "replicate" populations in the middle Gila/San Francisco Recovery Unit, thereby eliminating the requirement for establishment of new populations through reintroduction in Eagle and Bonita Creeks.

Response: We have modified Table 1 in the final Recovery Plan amendment to address this comment. The goal of these criteria are to ensure that each remnant population is replicated, and that the current distribution of loach minnow is expanded to more closely resemble its historical distribution. In the Middle Gila/San Francisco Recovery Unit, we consider the San Francisco River and its tributaries, the Blue River and its tributaries, and Eagle Creek as occupied by loach minnow. As noted in the response to *Comment* (3) above, we anticipate that, prior to finalization of the Recovery Plan revision, the definition of occupancy developed by the Recovery Team and the most recent monitoring information will be used to reach a final determination of occupied or extirpated, as appropriate, for streams such as Eagle Creek. This recovery unit may require only one additional repatriation under the new criteria because the distribution of loach minnow within the recovery unit more closely approximates its historical range than in other recovery units.

Comment (13): The commenter stated that the revised recovery criteria lack specific stream names for repatriation efforts. Specific streams should have been evaluated or included.

Response: Please see the response to *Comment* (1) above.

Comment (14): The commenter stated that adding recovery units is a substantive change; therefore, we think far more information about them should be presented here so that the public can better evaluate this amendment. Recovery units are restrictive but there is not enough information in this amendment to evaluate whether or not they are needed. It would have been better to explain the recovery units in the revised Recovery Plan before adding them in this amendment.

Response: We have added additional language to the Recovery Plan amendment to describe the basis for establishing recovery unites. The revised Recovery Plan will provide additional detail

on recovery units and the reasons for choosing to use recovery units versus management units. Please see the response to *Comment* (1) above.

Comment (15): The commenter requested clarification whether the remnant populations can be replicated in different recovery units.

Response: Please see the response to *Comment* (1) above. The revised Recovery Plan will contain the recovery actions that provide additional detail on where and in what types of stream conditions loach minnow will be repatriated, as well as which lineages will be used within each recovery unit.

Comment (16): The commenter stated that they agree there are three remnant populations in the San Francisco/Middle Gila, if they are Blue River, San Francisco River, and Tularosa River.

Response: Currently, the three remnant populations in the San Francisco/Middle Gila River are the San Francisco River and its tributaries (including the Tularosa River), the Blue River and its tributaries, and Eagle Creek. Please see the response to *Comment* (3) above regarding the inclusion of Eagle Creek as a remnant population.

Comment (17): The commenter requested a definition of refugia population for the phrase "…that total cannot include more than one refugia population". Although hatchery populations are critical to implement recovery actions, only wild populations should count toward downlisting.

Response. Please see the response to *Comment* (10) above. We agree that only wild populations should count toward downlisting, which is why we reference refugia population only in the downlisting criteria.

Comment (18): The commenter stated that it may not be feasible to develop and maintain hatchery populations for each genetic lineage. For populations that are extremely rare, or possibly extirpated, it may not be possible to get any fish to the hatchery. In addition, if a population is established at the hatchery, but then the wild population drastically decreases, it will not be possible to collect enough fish from the wild to maintain the hatchery population.

Response: We agree that for populations that are extremely rare or possibly extirpated, it is unlikely that we will be able to develop a hatchery stock, as has been the case for the Verde River and Eagle Creek, for example. We are currently completing a genetic analysis that will help inform how to best manage these lineages, should any individuals be found. Decisions as to next steps for those populations that are extremely rare will depend in large part on the genetic analyses and the ability to capture sufficient individuals to maintain the lineage.

Comment (19): The commenter stated that not establishing any mixed lineage populations in the wild seems shortsighted. Previously, downstream populations mixed with upstream lineages. Therefore, establishing a small proportion of the total populations as mixed populations would better mimic what used to happen. We suggest using a similar approach to the Gila Trout

Recovery Plan (2003), which calls for lineages to be replicated, but mixed populations are also established.

Response: We have not eliminated the mixing of genetic lineages for loach minnow. However, as advised by geneticists working with the Recovery Team, our first priority is replication of existing lineages. Following that, and with the guidance of a completed genetics analyses and a genetics management plan, we would consider evaluating the value of mixing genetic lineages for recovery of loach minnow. Please see the response to *Comment* (1) above.

Summary of Peer 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: appropriate private, State, and Federal agencies, Tribal governments, academia, non-governmental organizations, and private land owners. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to loach minnow, threats facing loach minnow, their life history, genetics, biology, and threats, stream ecosystems, and land management. 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 nine peer reviewers and received comments from three. Peer reviewers that responded included representatives from academia (Kansas State University) and one species expert from New Mexico.

In general, the draft amendment was well-received by the peer reviewers and garnered support as well as suggestions for clarification and improvement. Some comments received indicated confusion with the amendment process, given that a full Recovery Plan revision is underway for loach minnow. Others indicated disagreement on the number of populations identified in Table 1. Reviewers provided additional specific information, including documents or citations; we thank the reviewers for these data and we have added the information where appropriate.

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 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, are not addressed 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): The commenter stated that stream names for repatriation efforts, or a map detailing repatriation locations, would be helpful. It would be much clearer if locations of remnant and reintroduced populations were listed by the recovery unit and miles.

Response: The scope of a recovery plan amendment is strictly limited to the rewrite of a very specific section, supplementing that section but not completely replacing the existing recovery plan. This Recovery Plan amendment focuses on the establishment of quantitative criteria for

what constitutes a recovered species, and we are only supplementing the existing Recovery Plan with new information on two recovery criteria. A full Recovery Plan revision is underway for loach minnow, and is the appropriate process for updating all other Recovery Plan content, such as species background information, threats, the recovery strategy, goals and objectives, site-specific recovery actions, the estimated time and cost of recovery, and the implementation schedule.

Peer Review Comment (2): The commenter stated that not all populations seem equal, as some populations are smaller or are in smaller geographic areas (e.g., the Tularosa River).

Response: We are considering a population to include loach minnow in a given area that are connected such that breeding could occur. In the case of the Tularosa River, the population would actually consist of the Tularosa River, Negrito Creek, and the San Francisco River. A more extensive discussion of "populations" will be included in the Recovery Plan revision that is underway.

Peer Review Comment (3): The commenter stated that a five-year monitoring period is insufficient given that population and climatic cycles might occur over longer time periods. In addition, 5 years may be insufficient to indicate long-term stability in a population or capture the range of flows a stream is likely to experience.

Response: We have clarified in the final amendment that the five-year monitoring period applies to each site following successful repatriation. In addition to five years of post-repatriation monitoring, delisting of the species will require a post-delisting monitoring plan to be developed, with an additional minimum of five years of monitoring (see 50 CFR 17.11, 17.12, 224.101, and 227.4). Therefore, monitoring of repatriated populations would extend over a 10 or more year period.

Peer Review Comment (4): The commenter stated that most of the tributary streams noted at #2 under the Synthesis subheading are ephemeral and might not be able to develop into stable populations.

Response: The streams noted at #2 include North Fork East Fork Black River and its tributaries; as well as Dry Blue Creek, Frieborn Creek, Pace Creek, Mangas Creek, and Bear Creek. The Spikedace and Loach Minnow Recovery Team (Recovery Team) will assess the suitability of streams for loach minnow prior to any repatriation effort. When considering a stream complex for a repatriation effort, we will be focusing primarily on perennial streams but could include intermittent or ephemeral streams if they connect to perennial streams and could provide some benefit to loach minnow, such as a connective corridor.

Peer Review Comment (5): The commenter stated that three replicate populations seems like an absolute minimum for a recovery goal, but also seems highly dependent on where those populations are located. Wildfire, for example, can be widespread and affect multiple populations, as occurred with the Whitewater-Baldy Fire in 2012.

Response: Please see the response to *Peer Review Comment* (1) above. We recognize that large-scale perturbations such as the Whitewater-Baldy Fire could affect more than one population. We believe that increasing existing populations to a total of four populations in each of five recovery units will provide suitable resiliency, replication, and redundancy of populations to enable the species to persist, and will re-establish the distribution of loach minnow to those areas in which it was historically present. In addition, repatriation efforts are only one of the recovery criteria in the 1991 Recovery Plan. The Recovery Team is developing other criteria that address threats such as wildfire and threat responses in protecting remnant and repatriated populations of loach minnow.

Peer Review Comment (6): The commenter stated that the Service should have an open discussion with researchers that have an understanding of basic population biology and population genetics. Maintaining intact lineages may not be the best approach for conservation.

Response: Please see the response to *Peer Review Comment* (1) above. The Recovery Team is comprised of species and land management experts from state wildlife agencies in New Mexico and Arizona, tribes, the Service, Bureau of Land Management, Forest Service, academia, and others familiar with the species' natural history. In addition, we are working with researchers on genetic analyses that we will use in developing the Recovery Plan revision for loach minnow.

Peer Review Comment (7): The commenter stated that there should be a minimum stream length occupied by repatriated populations. It is hard to accept the reasoning in the document without knowing potential restoration streams, their length, and general habitat conditions.

Response: Please see the response to *Peer Review Comment* (1) above. Habitat assessments are currently underway to identify appropriate streams for repatriation efforts. Stream length, presence of water, the existing aquatic species community, and other factors will be considered when identifying suitable streams for repatriation efforts in the Recovery Plan revision.

Peer Review Comment (8): The commenter asked if remnant populations will be donors for repatriation efforts, and if the Service will follow the "nearest neighbor rule".

Response: Please see the response to *Peer Review Comment* (1) above. The specific details for each repatriation effort will be developed as recovery actions in the revised Recovery Plan. We are currently removing small numbers of fish from remnant populations and placing them into captive breeding stock at the Aquatic Research and Conservation Center (ARCC) with the goal of developing sufficient numbers of fish for repatriation efforts. This has proven successful in breeding more fish in captivity, rather than removing larger numbers of fish from remnant populations. Our goal is to have every extant lineage replicated; however, we also consider the "nearest neighbor rule" in placing fish out within each repatriation effort in order to ensure the greatest likelihood of success.

Peer Review Comment (9): The commenter asked if remnant populations would be augmented and similarly, is each recovery unit stocked only with individuals from that recovery unit's remnant population.

Response: Please see the response to *Peer Review Comment* (1) above. Results from genetic analyses that are underway will be incorporated in the Recovery Plan revision and will help to inform appropriate management and recovery efforts for remnant populations and repatriation efforts.

Peer Review Comment (10): The commenter requested clarification on what is meant by "…sufficient population numbers are required to ensure that they can be re-established?"

Response: This statement is in regards to the reason for establishing additional populations of loach minnow through repatriation efforts. To clarify, we believe that requiring three total populations for downlisting and an additional population for delisting will establish a sufficient number of populations for the species to withstand stochastic events. Loach minnow are short-lived, and can be difficult to capture and breed in captivity, which could mean that we are not able to re-establish the lost population immediately. Therefore, the remaining populations provide a safeguard while we work through the process of re-establishing a lost population.

Peer Review Comment (11): The commenter stated that the 1991 Recovery Plan does not mention climate change, but it needs to be considered now.

Response: Please see the response to *Peer Review Comment* (1) above. We anticipate that the revised Recovery Plan will address a variety of threats to loach minnow, including climate change, predation, and competition, as well as other recovery criteria and actions to address them.

Peer Review Comment (12): The commenter stated that maintaining each lineage in a hatchery will require periodic infusions of wild fish to maintain genetic diversity of the captive population, and this requires a lot of effort and a well-conceived genetics management plan.

Response. Please see the response to *Peer Review Comment* (1) above. The Recovery Team will use the results of genetic analyses to inform appropriate management steps for remnant and repatriated populations, as well as captive stock. We are additionally working with geneticists in development of a genetics management plan, and will finalize that plan once the results of genetic analyses are available.

Peer Review Comment (13): The commenter asked if each genetic lineage would be replicated more than one time and in more than one location within a recovery unit.

Response: Please see the response to *Peer Review Comment* (1) above. We will develop recovery actions that will result in the repatriation of genetic lineages in more than one location within a given recovery unit. Additionally, we will work with geneticists to determine if mixing of genetic lineages may be appropriate once each lineage has been repatriated per recovery criteria.