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

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DRAFT 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
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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 A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification.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 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. In addition, the U.S. Fish and Wildlife Service (Service) has expanded its recovery planning efforts to address the biodiversity principles of representation, resiliency, and redundancy. Finally, the Service recognized the need to provide additional detail on replication efforts, including how many replications are needed of each extant population, and where they might be placed, in order to better evaluate when downlisting and delisting are appropriate.

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 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 identifying 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, which is largely summarized in the Federal Register document reclassifying loach minnow to endangered status (77 FR 10810; USFWS 2012):

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, 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 (Pilger et al. 2015) assessed relatedness of loach minnow in the Gila Forks area and the mainstream Gila River, determining that the populations are still genetically connected.
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).
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).
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 (H. Blasius, pers. comm. 2018, Robinson and Love-Chezem 2016, Robinson 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, which will supersede Step 6 included in the 1991 Recovery Plan, as follows:

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

Downlisting Recovery Criteria
1. Remnant Populations. Maintain all 11 remnant populations of loach minnow in the wild at population levels identified in Table 1 (below) with trends of recruitment and population size indices considered stable or positive over the most recent rolling 10-year period. Conduct annual monitoring to document species persistence.

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 11 remnant loach minnow populations ensures the preservation of genetic lineages and thus the preservation of species representation across its range.

2. Replicate Populations. Within each Recovery Unit, the combination of remnant (Downlisting Criterion 1 above) and replicate populations must be three or more, as detailed in Table 1

(below). Because the recovery objective is to have the species persist without continual human management intervention, that total cannot include more than one refugia population. Replicates into new locations may require renovation to remove nonnative species that would compete with and prey on loach minnow. For wild populations, conduct annual monitoring to determine species are self-sustaining, as shown by persistence and reproduction, for five consecutive years following the last stocking effort at each site.

Justification: Replicates are reintroduced populations of loach minnow that are representative of the genetically distinct remnant populations. The Recovery Team has determined that two replications is appropriate within Recovery Units where there are existing remnant loach minnow populations. 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, the RU is not in immediate danger of extirpation as there would be two self-sustaining populations left in that RU. These replicate populations of loach minnow will increase the species redundancy within a given Recovery Unit, 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, as well as smaller, local perturbations such as a nonnative fish invasion, both of which have been identified as primary threats to the loach minnow.

Table 1. Minimum population needs for downlisting and delisting of loach minnow.

	Current	**Downlist**	**Delist**	
Recovery Unit (RU)	Number of Remnant Populations	Number of Replicate Populations Needed	Number of Additional Replicate Populations Needed	Total Number of Replicate Populations Needed
Verde/Lower Salt (RU1)	0	3	1	4
Upper Salt (RU2)	2	1	1	2
San Pedro/Lower Gila (RU3)	2	1	1	2
San Francisco/Middle Gila (RU4)	3	0	0	0
Upper Gila (RU5)	4	0	0	0
Cumulative Totals	**11**	**5**	**3**	**8**

Delisting Recovery Criteria

The loach minnow will be considered for delisting when the following criteria are completed in addition to the downlisting criteria above:

1. Remnant Populations. Maintain all populations of loach minnow defined in Table 1 (above). Conduct annual monitoring to determine species are self-sustaining, as shown by persistence and reproduction, for five consecutive years following the last stocking effort at each site.

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

2. Additional Replicate Populations. Within RU1, RU2, and RU3, replicate additional populations of loach minnow into new, unoccupied areas of each respective RU, as detailed in Table 1 (above). Conduct annual monitoring to determine species are persisting, as shown by persistence and reproduction, for five consecutive years following each repatriation. . 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 has determined 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 reintroduced replicate populations, should any one area be extirpated, sufficient other areas 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 re-established.

Rationale for Amended Recovery Criteria

The primary objective of the 1991 Recovery Plan is 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 recovery units 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 re-established 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 re-established populations, including invasion by nonnative aquatic species, are identified and addressed in a timely manner.

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