

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.

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Page(s) Superseded: 24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Page(s) Superseded: 8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Page(s) Superseded: 20-22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Page(s) Superseded: 37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Page(s) Superseded: 33-35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Page(s) Superseded: 10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Page(s) Superseded: None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Page(s) Superseded: 54-57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

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Page(s) Superseded: 13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Page(s) Superseded: 19-22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Page(s) Superseded: 11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:

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Recovery Plan for Spikedace (*Meda fulgida*)
https://ecos.fws.gov/docs/recovery_plan/910930d.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 spikedace (*Meda fulgida*) 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 19 - 22 of the recovery plan (Marsh 1991).

**For
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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 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 Spikedace 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 spikedace 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 and Loach Minnow (*Tiaroga cobitis*) Recovery Team (Recovery Team). The Technical Subcommittee of the Recovery Team will be completing revisions to the 1991 Spikedace 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 spikedace. In this amendment, we identify recovery units (RUs) and provide downlisting and delisting criteria 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 11 through 27).

Synthesis

New information on spokedace gained through research, monitoring, and studies includes the following, some of which is summarized in the Federal Register document reclassifying spokedace 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 Spring Creek, Fossil Creek, Blue River, Aravaipa Creek, Eagle Creek in Arizona and at the Gila River, Gila Forks area, and San Francisco River in New Mexico documents trends in population status (Bahm and Robinson 2009, Robinson and Love-Chezem 2016, NMDGF 2017, Freeport-McMoRan 2018, NMDGF 2018, P. Reinthal, University of Arizona, pers. comm. 2018). Monitoring has documented the persistence of repatriated spokedace populations in Fossil Creek, the Blue River, and Spring Creek (K. Mosher, AGFD, pers. comm. 2016, B. Hickerson, AGFD pers. comm. 2019a, 2019b).
- 2) Research on geographic patterns of genetic variation (Tibbets 1993, Tibbets and Dowling 1996) indicates that gene flow has been low but not historically absent, and that each remaining population is genetically distinct. Pilger et al. (2015) assessed the relatedness of spokedace in the Gila Forks area and the mainstream Gila River, determining that the populations are still genetically connected. Pilger et al. 2017 researched patterns of genetic variation in the Upper Gila River. Additional work on spokedace genetics is underway at this time.
- 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, Olden et al. 2006, Propst et al. 2008, Pilger et al. 2010, Whitney et al. 2014).
- 5) Additional monitoring documented the presence of nonnative fishes in systems occupied by spokedace (Springer 1995, Jakle 1995, Propst et al. 2009, ASU 2008, Paroz et al. 2009, Propst et al. 2009, Robinson and Love-Chezem 2016, NMDGF 2017, Freeport-McMoRan 2018).
- 6) Assessment of the impacts of wildfire on spokedace in the Gila River, New Mexico (H. Blasius, BLM, pers. comm. 2011, Patterson et al. 2012, Whitney et al. 2015a, Whitney et al. 2015b, Gido et al. 2019).
- 7) The ability to repatriate spokedace in new areas (Blasius and Conn 2015, Love-Chezem and Robinson 2015, M. Ruhl, NMDGF, pers. comm. 2017).
- 8) Completion of nonnative fish barrier construction at Aravaipa Creek, Hot Springs Canyon, Bonita Creek, and Blue River to protect habitat occupied by or for repatriation efforts of spokedace.
- 9) The ability to renovate streams by removal of nonnatives (H. Blasius, pers. comm. 2018, Robinson and Love-Chezem 2016, Robinson et al. 2017).
- 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 recover units and establish both downlisting and delisting criteria for the spikedace. The RUs are derived from the historical distribution of spikedace, 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 – San Pedro River/Lower Gila River
- RU 3 - San Francisco River/Middle Gila River
- RU 4 – Upper Gila River

Downlisting Recovery Criteria

1. Remnant Populations (Table 1, column 2). Maintain all 5 remnant populations of spikedace 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 spikedace remaining within the species’ historical range (Tibbets 1992, Tibbets and Dowling 1996). Maintenance of the 5 remnant spikedace 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 RU 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 RU.

3. Replicate additional populations of spikedace into new, unoccupied areas of each respective RU (Table 1, column 6). Repatriation of spikedace into new locations may require eradication 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 is 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 spikedace that have been repatriated to unoccupied and isolated streams, are representative of the genetically distinct remnant populations. The Recovery Team has recommended two replications within Recovery Units (RUs) where there are existing remnant spikedace populations, so that a total of three populations is achieved. The need for three spikedace 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 spikedace 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 or water loss, all of which have been identified as primary threats to the spikedace.

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).

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	1	0	0	1	2	1
RU2 – San Pedro/Lower Gila	1	0	1	2	1	1
RU3 – San Francisco/Middle Gila	1	0	0	1	2	1
RU4 – Upper Gila	2	0	1	3	0	1
TOTALS	5	0	2	7	5	4

Delisting Recovery Criteria

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

1. All four remnant (Table 1, column 2) and replicate (Table 1, column 3) populations of spokedace 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 spokedace into new unoccupied areas of each respective RUs (Table 1, column 7). Conduct annual monitoring to determine species is becoming established, as shown by persistence and recruitment, for five 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 spokedace.

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 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 spokedace 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 spokedace. 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 spikedace. Overall, spikedace are currently present in only 10 to 15 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 spikedace 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. 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 spikedace.

The five listing factors are evaluated in the 2012 Federal Register notice reclassifying spikedace 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 spikedace 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 spikedace 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 spikedace recovery. Modified downlisting and delisting criteria above require replicating spikedace 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 spikedace (*Meda fulgida*) 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 posted on the Service's Species Profile website (<https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6493>).

The Service received two responses to the request for public comment. These included comments from 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 incorporate as changes into the revised recovery plan did not warrant an explicit response and, thus, are not presented here.

Comment (1): The commenter stated that it would be good to have some type of parameters described for size or geographic range, viability, and/or connectivity between sites to help define "population".

Response: The scope of this 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 spikedace, 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 1 to identify the numbers of remnant, refugia, and recovery populations needed by recovery unit.

Comment (3): The commenters stated that there should be no viable remnant population of spikedace in the Verde/Lower Salt recovery unit or in Eagle Creek as they have not been detected in many years. Additionally, one commenter stated that, since spikedace could occur on portions of Eagle Creek on the San Carlos Reservation, the Service should work with tribes to

conduct surveys on tribal lands, or use current information from non-tribal lands to demonstrate that spikedace are extirpated from Eagle Creek.

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) as well as collection of eDNA. 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.

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): The commenter stated that persistence and reproduction as defined in the draft criteria is not objective or measurable. If two fish of different age classes are found in a single riffle, it does not indicate an entire stream is occupied or that a viable population exists.

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. In addition, 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). This information will be built into the Recovery Plan revision to help in determining appropriate sizes for repatriated populations.

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 spikedace, 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): The commenter stated that suitable habitat based on the PCEs similar to what is in the existing Recovery Plan should be included. Otherwise, this will continue the perception that as long as there is water, spikédace can be stocked.

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

Comment (8): The commenter stated that the definition of “replicate” does not address what it is spatially. Does 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). We have clarified in the final Recovery Plan amendment that replicates are populations of spikédace that have been repatriated to unoccupied and isolated streams.

Comment (9): 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 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 (10): 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 spikédace populations over a larger percentage of their historical range, as indicated by the down- and delisting criteria developed here. Once that is accomplished, we plan to discontinue refugia populations at ARCC, and we will be able to discontinue removing fish from remnant populations.

Comment (11): 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 spikedace to new locations within their historical range.

Comment (12): One commenter offered several comments regarding Factors C and E, noting that both address nonnatives, and both talk about curtailing transport and introduction of nonnative fishes. The commenter asked if invasion by nonnatives is a predation issue or should be considered under other natural/manmade factors. Similarly, the commenter stated that the threat of nonnatives in the future needs to be addressed, including how new detections would be dealt with expediently. Finally, the commenter noted that, with respect to nonnatives, Factor E should be focused on stopping the transport and introduction of nonnatives.

Response: Factor C addresses “Disease and Predation”, while Factor E addresses “Other Natural and Manmade Factors Affecting the Species’ Continued Existence”. We consider invasion by nonnatives is both a predation and a competition issue. We address predation under Factor C, and competition for resources in Factor E. The recovery plan amendment only summarizes how the 1991 Recovery Plan addresses the primary threats to spikedace. Both the final revised recovery plan and the 2012 reclassification rule for spikedace and loach minnow (77 FR 10810) provide a more detailed description of the factors, which may provide clarification on this topic.

Comment (13): 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 units. 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 (14): Commenters asked several questions regarding genetics, including whether remnant populations can be replicated in different recovery units and what will happen with rare lineages if we are not able to propagate them in captivity. Additionally, one commenter stated that not establishing any mixed lineage populations in the wild seems shortsighted.

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 spikedace will be repatriated, as well as which lineages will be used within each recovery unit. In addition, genetic analyses are underway which will help inform decisions on which lineages are used for replication, and in which streams. The genetics analysis will also assess the genetic diversity of each lineage, and determine if rare lineages are genetically robust enough for replication and repatriation. Finally, we have not eliminated the option of mixing of genetic lineages for spikedace. 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 spikedace.

Comment (15): The number of populations specified in the Upper Gila River Recovery Unit may be in error. To our knowledge, there are two populations: Gila River Forks and upper Gila River.

Response: Table 1 currently has a Gila River population and a Mangas Creek population of spikedace. Pilger et al. (2015) has indicated that there is still some level of genetic exchange between spikedace in the Gila Forks area and the mainstem Gila River. These populations remain hydrologically connected, although the intervening area does contain some nonnatives. Spikedace in Mangas Creek may be isolated from upstream movement of fish from the Gila River due to a drop off at a road crossing near its confluence with the Gila River that may be serving as a barrier. Please see the response to *Comment (1)* above.

Comment (16): The commenter stated that having recruitment and population size indices stable or positive over the most recent 10-year period may be reasonable for populations that are consistently detected, but it does not seem reasonable for locations where the species has not been detected in over 10 years (referring to East Fork Black River, Eagle Creek). To apply this to Eagle Creek and East Fork Black River would be to maintain them at zero, which does not seem reasonable.

Response: For populations that are currently at a reduced size such that we believe them to be unstable, efforts would be needed to stabilize the population prior to meeting criterion 1. We have amended this language under the downlisting and delisting criteria within the recovery plan amendment.

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 delisting, which is why we reference refugia population only in the downlisting criteria.

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 spikedace, threats facing spikedace, 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 spikedace. Others indicated disagreement on the number of populations identified in Table 1. Reviewers provided additional specific information, including documents of 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 spikedace, 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.

Response: We are considering a population to include spikedace in a given area that are connected such that breeding could occur. 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 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 spikedace 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 wildlife and threat responses in protecting remnant and repatriated populations of spikedace.

Peer Review Comment (5): 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 spikedace.

Peer Review Comment (6): The commenter stated that there have been no documented collections of spikedace from the Verde River in 20+ years nor from Eagle Creek for at least that long, and these populations are likely extirpated. There are only two remnant populations in Aravaipa Creek and the upper Gila River. It is unclear which population is the second population in the middle Gila River.

Response: Please see response to *Comment (3)* above.

Peer Review Comment (7): The commenter requested clarification for the statement "The need for three populations in each RU prior to downlisting...", and asked if this means there should be three restorations in recovery units without a spikedace population.

Response: We have clarified in the final amendment that any recovery unit without extant populations would require three replications for downlisting, and an additional population would be required for delisting.

Peer Review Comment (8): The commenter asked if there will only be one refugia population per lineage or per species.

Response: There can be as many refugia populations as can be supported by existing wild populations of spikedace. However, for purposes of downlisting criteria, we anticipate having only one refugia population per lineage.

Peer Review Comment (9): The commenter asked if studies should be conducted to determine if there are suitable but unoccupied habitats within recovery units.

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

Peer Review Comment (10): The commenter stated that the criteria do not provide information on how large the populations should be. See Connell & Sousa (1993) and Bogan et al (2013) for definition of resilience (referenced in Gido et al. 2019).

Response: Please see response to *Comment (5)* above.

Peer Review Comment (11): The commenter asked 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 spikedace 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. Spikedace 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 (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 stated that two populations of each lineage is not sufficient redundancy.

Response: The criteria in this Recovery Plan amendment require that each lineage be replicated to three populations for downlisting, and an additional population for delisting. Therefore, a total of four populations of each lineage is required for delisting spikedace.