RECOVERY PLAN AMENDMENTS FOR 20 SOUTHWEST SPECIES

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

Brady Pincushion Cactus (*Pediocactus bradyi*) Recovery Plan	
Original Recovery Plan Approved:	March 28, 1985
Page(s) Superseded:	19-34
Endangered Karst Invertebrates (Travis and Williamson Counties, Texas) Recovery Plan	
Original Recovery Plan Approved:	August 25, 1994
Page(s) Superseded:	86-88
Species Included:	Bee Creek Cave harvestman (*Texella reddelli*)
	Bone Cave harvestman (*Texella reyesi*)
	Coffin Cave mold beetle (*Batrisodes texanus*)
	Kretschmarr Cave mold beetle (*Texamaurops reddelli*)
	Tooth Cave spider (*Tayshaneta=Neoleptoneta myopica*)
	Tooth Cave ground beetle (*Rhadine persephone*)
	Tooth Cave pseudoscorpion (*Tartarocreagris texana*)
Holy Ghost Ipomopsis (*Ipomopsis sancti-spiritus*) Recovery Plan	
Original Recovery Plan Approved:	September 26, 2002
Page(s) Superseded:	18-21
Knowlton Cactus (*Pediocactus knowltonii*) Recovery Plan	
Original Recovery Plan Approved:	March 29, 1985
Page(s) Superseded:	16
Kuenzler Hedgehog Cactus (*Echinocerus fendleri* var. *kuenzleri*) Recovery Plan	
Original Recovery Plan Approved:	March 28, 1985
Page(s) Superseded:	13
Sacramento Prickly Poppy (*Argemone pleicantha ssp. pinnatisecta*) Recovery Plan	
Original Recovery Plan Approved:	August 31, 1994
Page(s) Superseded:	16-17
Siler Pincushion Cactus (*Pediocactus sileri*) Recovery Plan	
Original Recovery Plan Approved:	April 14, 1986
Page(s) Superseded:	19-41
Sneed and Lee Pincushion Cacti Recovery Plan	
Original Recovery Plan Approved:	March 21, 1986
Page(s) Superseded:	19
Species Included:	Sneed pincushion cactus (*Coryphantha sneedii* var. *sneedii*)
	Lee pincushion cactus (*Coryphantha sneedii* var. *leei*)
Socorro Isopod (*Thermosphaeroma thermophilum*) Recovery Plan	
Original Recovery Plan Approved:	February 16, 1982
Page(s) Superseded:	6-7, 10-11, 13

Star Cactus (*Astrophytum asterias*) Recovery Plan	
Original Recovery Plan Approved:	August 26, 2003
Page(s) Superseded:	11-14
Tobusch Fishhook Cactus (*Ancistrocactus tobuschii*) Recovery Plan	
Original Recovery Plan Approved:	March 18, 1987
Page(s) Superseded:	iii, 14-15
Zapata Bladderpod (*Lesquerella thamnophila*) Recovery Plan	
Original Recovery Plan Approved:	July 14, 2004
Page(s) Superseded:	9-11
Zuni Fleabane (*Erigeron rhizomatus*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1988
Page(s) Superseded:	14

For

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

August 2019

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

Date: 8/28/19

Recovery Plan for Socorro Isopod (*Thermosphaeroma thermophilum*)

Original Recovery Plan Approved: 1982
Original Recovery Plan Prepared by: New Mexico Department of Game and Fish (Santa Fe, New Mexico)

AMENDMENT 1
We have identified best available information that indicates the need to amend recovery criteria for this species since the Socorro Isopod (*Thermosphaeroma thermophilum*) Recovery Plan (Recovery Plan) was completed. In this proposed modification, we synthesize the adequacy of the existing recovery criteria, show amended downlisting and delisting criteria, and provide the rationale supporting the proposed recovery plan modification. The proposed modification is shown as an appendix that supplements the Recovery Plan, superseding only pages 6, 7, 10, 11, and 13 (U.S. Fish and Wildlife Service [Service] 1982).

For
U.S. Fish and Wildlife Service
Southwest Regional Office
Albuquerque, NM 87103

August 2019

BACKGROUND INFORMATION

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

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if 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 New Mexico Department of Game and Fish (Department or NMDGF) has a working relationship with the private land owner that contains the "Evergreen" water system. The "Evergreen" water system supplies water from Sedillo Spring to portions of an abandoned bath house, which supports the last remaining, wild population of Socorro isopod (isopod; Bowman 1981; Service 1978). During February through June 2018, staff of the Service met with or discussed this recovery plan review with the Department's conservation staff. The Service also reviewed the findings of peer reviewers, the 5-year review (Myers et al. 2009), other relevant, published literature, and contacted D. Trujillo and S. Shuster to discuss the research they conducted on Socorro isopod in cooperation with B. Lang, who is now deceased. We acknowledge the conservation efforts and extensive field work provided by B. Lang for this recovery plan review.

The current Recovery Plan (Service 1982, pages 12-13) has downlisting and delisting objectives, but these were not described in quantitative terms. When conducting this recovery plan review, we found it appropriate to amend the existing criteria with quantitative performance measures.

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 delisting factors.

Recovery Criteria

See previous version of criteria found in the Recovery Plan, outlined on pages 6 through 13 (Service 1982).

Synthesis

Since listing, many studies have been conducted that have added greatly to our knowledge of this species (Bowman 1981; Shuster 1981a, b; Jormalainen et al. 1997; Jormalainen et al. 1999a, b; Shuster et al. 2005; Lang et al. 2006; Myers et al. 2009; Bleakley et al. 2013). Field and laboratory data indicate that the life span of the Socorro isopod is one year or less (Shuster 1981a) and they are highly cannibalistic (Bleakley et al. 2013). In 1990, the Department built the Socorro Isopod Propagation Facility containing two parallel artificial spring fed systems (North Unit and South Unit), each with four cement tanks connected by runs, to provide additional habitat for Socorro isopods (NMDGF 2009). The Socorro Isopod Propagation Facility is fed Sedillo Spring water and located on property owned by the City of Socorro. By the late

1800s, all the flow of Sedillo Spring was intercepted and the spring-fed wetland habitat of the Socorro isopod was lost (Summers 1976). We refer to the constructed habitat features associated with the "Evergreen" water system and the Socorro Isopod Propagation Facility as "natural" sites since they are piped warm water from Sedillo Spring and all sites contain similar constructed habitat features.

Socorro isopods are subject to many perturbations that puts this species at risk of extinction (Myers et al. 2009). Chapin et al. (1979) described a complex movement of ground water from recharge along the eastern Magdalena Mountains mixing with geothermal fluids at an intersection of a tectonic fault in the Socorro Thermal Area to give rise to the warm Sedillo Spring source water that supports the Socorro isopod. The long term geologic stability of the Socorro Thermal Area remains unknown (NMDGF 2009). In 1995, the water quality changed as temperatures cooled and the Socorro isopod was extirpated from the Socorro Isopod Propagation Facility South Unit (NMDGF 2001). In 1998, tree roots occluded the piping from Sedillo Spring, causing the Evergreen water system to dry with extensive loss of Socorro isopods (NMDGF 2001). In 1999, a contamination event extirpated the Socorro isopod from the Socorro Isopod Propagation Facility North Unit (Lang et al. 2006). The Socorro isopod was repatriated into these three, spring-fed systems using individuals from a captive population maintained by the City of Albuquerque Biological Park (NMDGF 2001). However, over time, the captive population may have undergone significant genetic and morphological divergence from the wild population (Shuster et al. 2005; Bleakley et al. 2013).

One downlisting criterion (Recovery Action 2.2) recommended translocation of the Socorro isopod to Fort Harmony Spring (now known as Ojo Caliente) along Alamosa Creek, near the ruins of Fort Harmony in Socorro County, New Mexico. Ojo Caliente contains the endangered Alamosa springsnail (*Pseudotryonia alamosae*) (NMDGF 2008). Given the risks from introducing the carnivorous Socorro isopod outside of its range and into habitats containing Alamosa springsnail, this action is no longer feasible, nor recommended (Myers et al. 2009).

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or no longer meets the definition of an endangered or threatened species 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 endangered to threatened. The term "endangered species" means any species 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. The numbering used below is not sequential, as the numbers refer to the specific criteria being amended from the original Recovery Plan (Service 1982).

We provide both downlisting and delisting criteria for the Socorro isopod, which will supersede those included in the existing Recovery Plan (Service 1982), as follows:

Downlisting Recovery Criteria

The following recovery actions and downlisting criteria are amended (*in italics*) as follows:

1.2.2.5. Monitor Status of Existing Population and Habitat.
The present isopod population and habitat will be monitored at least annually to ensure that the conditions specified in the easement agreement concerning tasks 1221, 1222, and 1223 are met. *The protected Socorro isopod population in the "Evergreen" water system must contain an average of at least 1,850 reproductive adults per square meter as determined from three benthic grab samples (described by NMDGF 2009) conducted within any pool habitats.*

Justification: The NMDGF described a mean density of at least 1,850 adult Socorro isopods as appropriate (Trujillo 2018) because high densities, along with habitat diversity, countered the threats of predation and population collapse (Lang et al. 2004). Reproductive adults were selected as a consistent metric for quantifying recovery rather than juveniles because the age structure of a population can shift to dominance by juveniles based on the season of sampling, the type of habitat, the presence of vertical structure, or the sampling methods selected (NMDGF 2009). Since the number of pool habitats can vary by each site, we proposed to use the average from all sampling efforts conducted in pool habitats.

2.3. Monitor and Manage Transplanted Isopod Populations and Habitat.
Monitor and document establishment of new populations of isopods at least annually. Biological parameters such as reproductive success, growth rates, habitat usage, and survival of young and other data should be gathered. *The Socorro isopod populations in the Socorro Isopod Propagation Facility (in both the North Unit and in the South Unit) must contain an average of at least 1,850 reproductive adults per square meter as determined from three benthic grab samples (described by NMDGF 2009) conducted within any pool habitats.*

Justification: The NMDGF described a mean density of at least 1,850 adult Socorro isopods as appropriate (Trujillo 2018) because high densities, along with habitat diversity, countered the threats of predation and population collapse (Lang et al. 2004). Reproductive adults were selected as a consistent metric for quantifying recovery rather than juveniles because the age structure of a population can shift to dominance by juveniles based on the season of sampling, the type of habitat, the presence of vertical structure, or the sampling methods selected (NMDGF 2009). Since the number of pool habitats can vary by each site, we proposed to use the average from all sampling efforts conducted in pool habitats.

3.0. Maintain Captive Populations.
Maintain captive populations with sufficient numbers of Socorro isopods to augment all three natural sites (at facilities authorized by the Service's Southwest Regional Director), which are genetically indistinguishable to the natural population. Genetically indistinguishable means the 95 percent confidence intervals of all genetic markers measured in the captive population are not significantly different from those measured in the Evergreen population. Develop and implement a Captive Propagation and Genetics Management Plan by the end of 2023 that describes the monitoring, management (including sufficient gene flow among all populations to prevent genetic divergence), and

measures necessary to ensure genetically diverse captive populations of Socorro isopod can be maintained to repatriate any populations that may become extirpated and for research purposes.

Justification: Having captive populations of Socorro isopod, which are genetically indistinguishable from those in the wild, conserves this species in the case of catastrophic population loss at any or all three natural habitat sites by the current landscape threats until habitat protections are secured (Lang et al. 2004).

Delisting Recovery Criteria
The Socorro isopod will be considered for delisting when:

6. After three wild populations and a captive population of Socorro isopod are established, and found to be stable and protected; the Socorro isopod could be delisted with the following additions (*amended criteria are in italics*):

6.1. *Documentation of annual Socorro isopod abundance (that is, an average of at least 1,850 reproductive adults per square meter as determined from three benthic grab samples conducted at least annually) in three, natural habitat sites (that is, the "Evergreen" water system, and two additional habitat sites that may include the North Unit and the South Unit of the Socorro Isopod Propagation Facility) must be maintained for at least 20 years. All three natural habitat sites must have pools that contain a diverse physical structure or vegetation sufficient to provide adequate breeding, feeding, and sheltering habitats for all life stages of the Socorro isopod. These natural habitat sites must be managed through voluntary, long-term landowner agreements (such as stewardship plans, easements, or memoranda of agreements) that identify maintenance of Socorro isopod as the primary management objective for the site. Or, these sites must be protected by permanent conservation easements or covenants that commit present and future landowners to the conservation of Socorro isopod, such that the species no longer meets the definition of an endangered or threatened species and may be delisted.*

Justification: The management of Socorro isopod in three natural habitat sites through landowner agreements that identify maintenance of Socorro isopod as the primary management objective for these sites along with captive propagation and genetic management will ensure species resilience, representation, and redundancy. Formal landowner agreements or conservation easements will maintain or allow delivery of Sedillo Spring water to the natural habitat sites, will maintain adequate Socorro isopod habitat conditions for breeding, feeding, and sheltering, and will allow free access by Departmental staff (or others) for monitoring, habitat maintenance, and population management, for a long duration (that is, greater than 20 years) or into perpetuity.

6.2. *Develop and implement a Captive Propagation and Genetics Management Plan by 2023 such that genetic markers are regularly monitored (at least every three years) in the captive Socorro isopod populations and these genetic markers are statistically indistinguishable from those measured in the natural Socorro isopod populations. The Captive Propagation and Genetics Management Plan should formalize and standardize all necessary genetic monitoring protocols, the number, type, and genetic markers that*

will be measured, and the captive propagation and genetic maintenance practices necessary to maintain the captive populations as statistically indistinguishable from the natural habitat populations.

Justification: Long-term species management of genetically diverse captive populations, which are monitored and managed to be indistinguishable from the natural populations, will allow species management to ameliorate the threats of habitat destruction, modification, or curtailment, disease, predation, catastrophes, or other natural or anthropogenic factors until recovery of Socorro isopod can occur in the wild (Lang et al. 2004).

6.3. *A monitoring plan to cover a minimum of five years post-delisting of Socorro isopod has been approved by the Southwest Regional Director and is ready to be implemented at the time of delisting to ensure the ongoing conservation of the species and the continuing effectiveness of management actions.*

Justification: Observing, monitoring, and managing the Socorro isopod for as many as five years post-delisting will provide assurance that the abundance and distribution of the Socorro isopod are fluctuating within expected levels and that genetically diverse captive populations are available to support recovery.

All classification decisions consider the following five factors: (1) is there a present or threatened destruction, modification, or curtailment of the species' habitat or range; (2) is the species subject to overutilization for commercial, recreational, scientific, or educational purposes; (3) is disease or predation a factor; (4) are there inadequate existing regulatory mechanisms in place outside the Endangered Species Act (taking into account the efforts by states and other organizations to protect the species or habitat); and (5) are other natural or manmade factors affecting its continued existence. When delisting or downlisting a species, we first propose the action in the *Federal Register* and seek public comment and peer review. Our final decision is announced in the *Federal Register*.

Rationale for Recovery Criteria

Our understanding of the species' status, threats, or recovery needs has not changed. The Socorro isopod is a rare crustacean that survives today in three habitat sites supplied by Sedillo Spring water entirely on private land in Socorro County, New Mexico. The Socorro isopod is endangered because of destruction and modification of its habitat. Current threats to Socorro isopod, in addition to their dependence on a highly restricted and fragile ecosystem, include threats to the underground water supply, reduced water flow, altered water quality, predation, and vandalism or other disturbances (Myers et al. 2009; NMDGF 2009). Over the last 25 years, the private landowner, the City of Socorro, the Department, researchers, and the City of Albuquerque Biological Park have reduced the magnitude or frequency of threats and have managed to assure the continuity of this species. However, Socorro isopod has limited range, limited mobility, and fragmented habitat subject to perturbations that puts this species at a high risk of extinction.

The knowledge base for the Socorro isopod has significantly increased since listing (Myers et al. 2009). This species is highly cannibalistic, with males more cannibalistic than females, and with females and juveniles more vulnerable than males as prey (Shuster et al. 2005). Cannibalism is now considered a threat to the Socorro isopod (Shuster et al. 2005; Bleakley et al. 2013). Females have many reproductive cycles over their lifetime and breed throughout the year (Shuster 1981a). Short reproductive cycles allow for genetic alterations to become manifest within six years (Shuster et al. 2005). Socorro isopod feed on detritus and algae, but are also facultative carnivores, preying on aquatic insect larvae as well as on each other (Shuster 1981a; Jormalainen and Shuster 1997; Bleakley et al. 2013). In the natural population, juveniles (called 'mancae') and some females were found mainly on vegetation, whereas adults and most male isopods were found mainly on bottom sediments (Jormalainen and Shuster 1997). They also showed that diverse vertical structure provided by rocks and vegetation can provide refugia to females and juveniles from predation. Therefore, diverse physical structure or vegetation has been incorporated into the habitat function described in delisting criteria 6.2.

Shuster et al. (2005) showed that physical separation of captive subpopulations from the natural population, combined with selection on the captive subpopulations resulting from age- and sex-specific cannibalism, resulted in significant genetic divergence between natural and captive subpopulations, as well as significant divergence in body size. Therefore, active management of physical habitat, routine exchanges of individuals from captive and natural populations, and genetic monitoring is necessary to preserve the genetic integrity of this species. Captive propagation and genetics management will continue to play a major role in the recovery and management of the endangered Socorro isopod in the foreseeable future.

Myers et al. (2009) reviewed the five factors of threats, conservation measures, and inadequate regulatory mechanisms to the status of the Socorro isopod. With new information on threats and life history, it is now feasible to describe quantitative criteria for isopod recovery and amend the original Recovery Plan (Service 1982). The management of Socorro isopod in three natural and artificial habitats through landowner agreements that identify maintenance of Socorro isopod as the primary management objective for these sites (along with captive propagation and genetic management) will ensure species resilience, representation, and redundancy. Long-term management of these three natural sites along with a genetically diverse captive population will ameliorate the effects of destruction, modification, or curtailment of their habitat as well as reduce the population or genetic losses due to disease, predation, catastrophes, or other natural or anthropogenic factors affecting Socorro isopod survival in the wild.

These amended recovery criteria are objective and measurable, establish abundance and occupancy in multiple habitat management units, and protect and manage a viable, genetically diverse captive population until threats can be addressed through implementation of the Recovery Plan. The quantitative delisting criteria describe the ability of management actions to sustain the Socorro isopod in three natural habitat sites and in captive populations over a biologically meaningful timeframe within the conditions on the landscape and inherent biological limitations of the species. Observing, monitoring, and managing the Socorro isopod for as many as twenty years will provide assurance that the abundance and distribution of isopods are fluctuating within expected levels and that a genetically diverse captive population is available to support recovery. Natural and captive populations will have access to diverse

habitat structure and identical genetic representation through management, individual exchange, and monitoring such that threats will be ameliorated and buffer the species response to environmental changes over time to provide security against extinction. Based on the best available information that includes the input and data from the Department during our recovery criteria review, the delisting criteria provide quantifiable measures for identifying and implementing recovery actions, a means to measure progress towards recovery, and the ability to recognize when recovery will be achieved.

ADDITIONAL SITE-SPECIFIC RECOVERY ACTIONS

Not applicable.

COSTS, TIMING, PRIORITY OF ADDITIONAL RECOVERY ACTIONS

Not applicable.

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

Summary of Public Comments

The Service published a notice of availability in the *Federal Register* on January 31, 2019 (84 FR 790-795) to announce that the draft amendment for the Socorro Isopod (*Thermosphaeroma thermophilum*) 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 revision. An electronic version of the draft amendment was also posted on the Service's Socorro Isopod Profile website (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=2470).

We also developed and implemented an outreach plan that included (1) publishing a news release on our national webpage (https://www.fws.gov/news/) on January 30, 2019, (2) sending specific notifications to Congressional contacts in Districts (include appropriate Districts, consult the corresponding Outreach Plan or contact your Regional Public Affairs Officer for more information), and (3) sending specific notifications to key stakeholders in conservation and recovery efforts. These outreach efforts were conducted in advance of the *Federal Register* publication to ensure that we provided adequate notification to all potentially interested audiences of the opportunity to review and comment on the draft amendment.

The Service received two responses to the request for public comment. These were from the Center for Biological Diversity and the Energy and Wildlife Action Coalition.

Public comments ranged from providing minor editorial suggestions to specific recommendations the amendment content. We have considered all substantive comments; we thank the reviewers for these comments and to the extent appropriate, we have incorporated the applicable information or suggested changes into the final Recovery Plan amendment. In general, these comments did not lead to significant changes in the draft amendment. Below, we provide a summary of public comments received; however, some of the comments that we incorporated as changes into the Recovery Plan amendment did not warrant an explicit response and, thus, are not presented here.

Comment (1): Concern that, "criteria are being added in the absence of any scientific peer review and that this will lead to a failure on the Service's part to follow the best-available science."

Response: Peer review was conducted following the publication of the Notice of Availability, and in accordance with the requirements of the Endangered Species Act (Act). Below we provide a detailed summary of peer review comments and our responses, where appropriate.

Comment (2): Concern that, "the decision to update recovery criteria for these 42 species as a group is indicative of the Service moving away from utilizing recovery teams and outside scientific expertise."

Response: Section 4 of the Act provides the Service with the authority and discretion to appoint recovery teams for the purpose of developing and implementing recovery plans. The current effort to update recovery plans with quantitative recovery criteria for what constitutes a recovered species is not indicative of the future need for, and does not preclude the future utilization of, recovery teams to complete recovery planning needs for listed species.

Comment (3): New and significant information has been developed in the years since the existing Recovery Plan was adopted. Updating this plan can serve to better inform the Service, the regulated community, and Federal, State, and local resource agencies.

Response: A recovery plan should be a living document, reflecting meaningful change when new substantive information becomes available. Keeping a recovery plan current increases its usefulness in recovering a species by ensuring that the species benefits through timely, partner-coordinated implementation based on the best available information.

Comment (4): The Service should consider whether the updated recovery criteria would be less burdensome on Federal agencies and the regulated community than the existing criteria.

Response: Recovery plans are guidance documents that outline how best to help listed species achieve recovery, but they are not regulatory documents. Recovery plans are intended to establish goals for long-term conservation of listed species and define criteria that are designed to indicate when the threats facing a species have been removed or reduced to such an extent that the species may no longer need the protections of the Act.

Recovery criteria are achieved through the funding and implementation of recovery actions by both the Service and our partners. In addition to the existing recovery actions included in each of these recovery plans, the amendments address the need for any new, site-specific recovery actions triggered by the modification of recovery criteria, along with the costs, timing, and priority of any such additional actions. Because recovery plans are not regulatory documents, identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in a recovery plan should be construed as a commitment or requirement that any Federal agency obligate or provide funds.

Comment (5): The Service should consider whether the recovery criteria are achievable, because including unattainable recovery criteria could render such plans meaningless, or impede other processes under the Act.

Response: The National Marine Fisheries Service and U.S. Fish and Wildlife Service Interim Endangered and Threatened Species Recovery Plan Guidance (2010) emphasizes the development of recovery criteria that are specific, measurable, achievable, realistic, and time-referenced (SMART). The achievable component of SMART criteria implies that the authority, funding, and staffing needed to meet recovery criteria are feasible, even if not always likely. In developing recovery criteria specifically, we attempt to establish criteria that are both scientifically defensible and achievable to the greatest extent possible. At times, however, the feasibility of achieving certain criteria can be, or appear to be, constrained by the particular, difficult circumstances that face a species. Even in such cases, criteria serve to guide recovery

actions and priorities for the species. Furthermore, as recovery progresses, periodic reevaluation of the species status through the 5-year review process may reveal that the barriers to achieving certain criteria have been removed or that circumstances or our understanding of the species have evolved. In that event, the Service can revise recovery criteria to ensure that they reflect the strategy most likely to succeed in the goal of recovery.

Comment (6): The Service should consider conservation efforts that have been put into place for the listed species since the previous iteration of the recovery plan, especially where the Service has supported conservation efforts, in formulating recovery criteria that will be established or amended by the revised draft plan.

Response: While section 4 of the Act directs the Service to specifically develop and implement recovery plans, several other sections of the Act and associated programs and activities also provide important opportunities to promote recovery. Information from these programs and activities about the biological needs of the species can inform recovery planning (including the formulation or revision of recovery criteria) and implementation. These conservation efforts have been considered during the development of this and other recovery plans.

Comment (7): The Service should determine whether ongoing species conservation efforts beneficially address one or more of the listing factors set forth in the Act implementing regulations addressing species listings and designation of critical habitat.

Response: All Service decisions that affect the listed status or critical habitat designation of a particular species, including our 5-year review of each listed species, are made by analyzing the five factors described in section 4 of the Act. Such an analysis necessarily includes an assessment of any conservation efforts or other actions that may mitigate or reduce impacts on the species. While our objective with this particular effort was to establish objective, measurable criteria for delisting, conservation actions play a crucial role in determining if and when those criteria have been satisfied.

Comment (8): The Service should be mindful of the impacts that recovery plan criteria can have on the section 7 process of the Act for the regulated community, because the Service and other Federal resource agencies sometimes request that recovery criteria be addressed in biological assessments and other planning processes under the Act addressing listed species.

Response: Recovery plans can both inform, and be informed by section 7 processes of the Act. When revising a recovery plan, existing section 7 consultations may provide helpful information on: recent threats and mechanisms to avoid, minimize, or compensate for impacts associated with those threats; a summarized status of the species; and indication of who important partners may be. Section 7 consultations can inform the need for revised recovery actions, recovery implementation schedule activities, recovery criteria, or species status assessments to provide more comprehensive recovery planning while the species remains listed.

Comment (9): The Service should include the full panoply of current information available for the species in all revised draft recovery plans.

Response: Our recovery planning guidance recommends that recovery planning be supported by compilation of available information that supports the best possible scientific understanding of the species. Although it is not necessary to exhaustively include all current information within the text of the recovery plan, to the extent that this information is specifically relevant and useful to recovery, the recovery plan may summarize such material or incorporate it by reference. Supporting biological information may also be included within a species status assessment or biological report separate from the recovery plan document itself.

Comment (10): The Service should consider whether the existing recovery plan should be revised or replaced in its entirety rather than amended in part.

Response: Under guidance established in 2010, partial revisions allow the Service to efficiently and effectively update recovery plans with the latest science and information when a recovery plan may not warrant the time or resources required to undertake a full revision of the plan. To further gauge whether we had assembled, considered, and incorporated the best available scientific and commercial information into this recovery plan revision, we solicited submission of any information, during the public comment period, that would enhance the necessary understanding of the species' biology and threats, and recovery needs and related implementation issues or concerns. We believe the recovery plan amendment, which targets updating recovery criteria, is appropriate for the species. However, we will also continue to evaluate the accuracy and usefulness of the existing recovery plan with respect to current information and status of conservation actions, and may pursue a full revision of the plan in the future, if appropriate.

Summary of Peer and Partner Review Comments

In accordance with the requirements of the Act, we solicited independent peer review of the draft amendment from the New Mexico Department of Game and Fish, academic and scientific groups, and individuals; and any other party that may have possessed pertinent information. Peer review was conducted concurrent with the *Federal Register* publication. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to the Socorro isopod (*Thermosphaeroma thermophilum*) and aquatic invertebrate ecology. 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 three peer reviewers. We received comments from all three. Peer reviewers that responded included one representative from the New Mexico Department of Game and Fish, and two academics (Northern Arizona University and University of California, retired). In general, the draft recovery plan amendment was well-received by the reviewers and garnered positive and clarifying comments. One reviewer provided additional specific information, including documents or citations; we thank the reviewers for these data, their reviews, comments, 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): We received comments stating that an objective, specific number of juveniles necessary to ensure self-perpetuation were not described.

Response: We revised the quantitative criteria for the recovery plan amendment to only include breeding adults and we no longer include reference to juveniles. Breeding adults alone would be able to perpetuate the species. Because the proportion of the population of juveniles varies by season, habitat type, and sampling methods, we removed these narrative criteria from the description of the quantitative criteria of breeding adults necessary for self-perpetuation.

Peer Review Comment (2): We received comments stating that the number of breeding adults in captive populations necessary to augment or repopulate the three natural habitat sites in the event of catastrophic events were not supported.

Response: We agree with the reviewers that the number of captive populations and facilities to house those populations could total more than one. Additionally, the number of individual adults or juveniles necessary to augment or repopulate one to three natural habitat sites might vary by the extent and severity of the catastrophic events. We determined that the number of adults or juveniles in captive populations necessary to augment or repopulate the natural habitat sites will be derived by the Captive Propagation and Genetics Management Plan by 2023. This Plan will also address genetic integrity issues that cannot be determined at this time. Therefore, we removed the specific numeric goals for the captive populations.

Peer Review Comment (3): We received a comment stating that the exact physical structures and vegetation necessary for optimal habitat were not described.

Response: We further described the function that cover and physical habitat diversity plays in the support of breeding, feeding, and sheltering of all life stages of Socorro isopod. Physical habitat diversity can be provided by 100 percent cobbles or by any type of vegetation in providing cover for smaller juveniles and females from cannibalism. We did not further quantify the type of physical habitat necessary to achieve those goals because these features could vary with each habitat site.

Peer Review Comment (4): We received comments stating that monitoring requirements when Socorro isopod is federally-listed versus when Socorro isopod is delisted were unclear.

Response: We clarified the goals for monitoring Socorro isopods using three benthic grab samples from any pools within the natural habitat sites. Since the "Evergreen" site has only one pool, then the number of benthic grab samples from that pool would be three. The results of the number of adult Socorro isopods would then be averaged for that pool and reported at least annually. As different natural habitat sites might vary by the number of times they are sampled,

by the number of pools that are sampled, or by the season of collection, we used the average result as the metric for evaluating the status of the Socorro isopod population at a site. Averaging would also address issues such as population fluctuations. The number of 1,850 breeding adults is sufficiently high to represent a thriving Socorro isopod population yet not too high to be achieved and is well above 100 individuals that are associated with population collapse. Such monitoring should occur for a total of 20 years while the Socorro isopod is federally listed. Socorro isopod have short lifespans (one year or less), therefore, 20 years of monitoring addresses over 60 generations of the Socorro isopod and would also be sufficient time to evaluate the likelihoods of management actions during and after catastrophic events. When the Socorro isopod is delisted, then only five additional years of monitoring would be necessary.

Peer Review Comment (5): We received a comment stating that the minimum number of adults per square meter is reasonable but needs to be described for more habitats.

Response: We amended the narrative to result in an average of 1,850 reproductive adults per square meter using three benthic grabs from any number of pools sampled within a year, including up to four pools each at the Socorro Isopod Propagation Facility North Unit and South Units. However, we did not intend for these criteria to apply to run habitats as the number of breeding adults would be consistently lower in that type of habitat due to their habitat preferences.

Peer Review Comment (6): We received a comment stating that the number of captive propagation facilities may be at least two and the number of Socorro isopods at these facilities could vary in number.

Response: We have revised the narrative to refer to more than one captive population as the risks to any one facility experiencing a catastrophic event are reduced by having more than one facility. Additionally, the number of individuals at a captive propagation facility could vary for a number of reasons and the number necessary for augmentation, research, and repopulation of a natural habitat site may also vary based on the required genetic management necessary. We will require the Captive Propagation and Genetics Management Plan to specify the number of Socorro isopod that are necessary to achieve the goals of maintaining genetic diversity and sufficient individuals necessary in the event of catastrophic events.

Peer Review Comment (7): We received a comment that the Captive Propagation and Genetics Management Plan should describe the genetic markers and the criteria for evaluation.

Response: We revised the description of the Captive Propagation and Genetics Management Plan to include the number and type of genetic markers to be measured, the protocols of monitoring and the goal for determining that the genetic markers measured must be indistinguishable in the captive population as compared with the natural habitat populations.

Peer Review Comment (8): We received a comment that the descriptions of the permanent conservation easements or covenant in the amendment are vague.

Response: Comment acknowledged. We clarified the amendment narrative to further describe the nature and function of the permanent conservation easements or covenants. Additional detail on the nature and function of these types of agreements were also described by the original recovery plan narrative.

Peer Review Comment (9): We received a comment that the monitoring plan of 5 years duration is too short.

Response: We clarified the amendment narrative to describe the minimum of 20 years of monitoring necessary to document abundance of breeding adults while Socorro isopod is listed and 5 years of planned monitoring are necessary when Socorro isopod is delisted.

Peer Review Comment (10): We received a comment that there is not a section that assesses the current risk to Socorro isopod. The risks to Socorro isopod could increase with further development that changes the water table, development of geothermal projects that divert water supplies or change the nature of the Socorro Thermal Area.

Response: We included additional detail in the synthesis section of the recovery amendment. Furthermore, in the next 5-year review of the status of the species or in a revised recovery plan, we will update the threats and risks posed to Socorro isopod.

Peer Review Comment (11): We received a comment that there is a possibility that Socorro isopod may persist in the Sedillo Spring collection gallery in the Socorro Thermal Area and that area should be surveyed to determine their presence there.

Response: The revised recovery criteria included in this amendment are based on new information that has been identified since the original recovery plan was developed. As the presence of Socorro isopod in the Sedillo Spring collection gallery has not been verified, we did not include this information in the final recovery plan amendment. However, we will request surveys of the infiltration gallery to determine the species' presence in this area.

Peer Review Comment (12): We received a comment that the commitment and efforts of the New Mexico Department of Game and Fish are to be applauded.

Response: We agree, the staff of the New Mexico Department of Game and Fish have been instrumental in securing the Socorro isopod from extinction.