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, NM)

DRAFT AMENDMENT 1
We have identified best available information that indicates the need to amend recovery criteria for this species since the Socorro Isopod 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 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

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Approved: _____DRAFT_____ Date: _____
Regional Director, Region 2
U.S. Fish and Wildlife Service

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 A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification.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 *in cite*) has a working relationship with the private land owner that contains the "Evergreen" water system. The "Evergreen" water system supplies water from Sedillo Spring, which supports the last remaining, wild population of Socorro Isopod (Bowman 1981; Service 1978). During February through June 2018, staff of the US Fish and Wildlife Service met with or discussed this recovery plan review with the Department's conservation staff. The Service also reviewed the findings of the 5-year review (Myers et al. 2009), other relevant, published literature, and contacted D. Trujillo and S. Shuster to discuss their work on Socorro Isopod with Brian Lang, who is now deceased. We acknowledge the conservation and extensive field work provided by B. Lang for this recovery plan review.

The current Recovery Plan (Service 1982) has adequate downlisting and delisting criteria, but these were not described in quantitative terms. When conducting this recovery plan review we found it most 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 in 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; and Lang et al. 2006; Myers et al. 2009). 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. 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 Isopod (NMDGF 2009). The

Socorro Isopod Propagation Facility is fed Sedillo Spring water and located near the native habitat on property owned by the City of Socorro.

Socorro Isopod is subject to many perturbations that puts this species at risk of extinction (Myers et al 2009). In 1998, tree roots occluded the drainage from Sedillo Spring, causing the Evergreen spring system to dry with extensive loss of Socorro Isopod (NMDGF 2001). In 1995, water quality changed and temperatures cooled and Socorro Isopod was extirpated from the South Unit (NMDGF 2001). In 1999, a contamination event extirpated Socorro Isopod from the North Unit (Lang et al. 2006). Socorro Isopod was soon repatriated into these three spring systems using individuals from captive populations maintained by the City of Albuquerque Biological Park (NMDGF 2001). However, over time, the captive populations have undergone significant genetic and morphological divergence from the natural population (Shuster et al. 2005).

One downlisting criterion (Recovery Action 2.2) recommended translocation of 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 a 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). Therefore, we are amending the Recovery Plan to remove this Recovery Action 2.2.

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 Socorro Isopod 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.

Based on Bowman (1981), we are correcting the taxonomic name of Socorro Isopod to *Thermosphaeroma thermophilum*. In addition to the removal of Recovery Action 2.2., we provide both downlisting and delisting criteria for the Socorro Isopod, which will supersede those included in Socorro Isopod 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 natural "Evergreen" spring system must contain at least 1,850 reproductive adults per square meter as determined from three benthic grab samples (described by NMDGF 2009) conducted*

within a pool habitat along with the presence of juveniles sufficient to ensure self-perpetuation.

Justification: The NMDGF described a mean density of at least 1,850 adult Socorro isopods as appropriate (Trujillo 2018) since high densities, along with habitat diversity, countered the threats of predation and population collapse (Lang et al. 2002).

2.2. (Formerly 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 protected Socorro Isopod population in the Socorro Isopod Propagation Facility North Unit and South Unit must contain at least 1,850 reproductive adults per square meter as determined from three benthic grab samples (described by NMDGF 2009) conducted within a pool habitat along with the presence of juveniles sufficient to ensure self-perpetuation.*

Justification: The NMDGF described a mean density of at least 1,850 adult Socorro isopods as appropriate (Trujillo 2018) since high densities, along with habitat diversity, countered the threats of predation and population collapse (Lang et al. 2002).

3.0. Maintain Captive Populations.
Maintain a captive population with sufficient numbers of Socorro Isopods to augment all three natural sites (at least 7,400 adults at a facility 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 wild population. Develop and implement a Captive Propagation and Genetics Management Plan by the end of 2023 that describes the management (including sufficient gene flow among all populations to prevent genetic divergence) and measures necessary to ensure a genetically diverse captive population of Socorro Isopods can be maintained to repatriate any populations that may become extirpated and for research purposes.

Justification: Having a captive population of at least (1,850 x 4 =) 7,400 Socorro isopods, 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 habitats by the current landscape threats until habitat protections are secured (Lang et al. 2002).

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

6. After three natural populations and a captive population of Socorro Isopod are established, and found to be stable and protected; the isopod could be delisted with the following additions:

6.1. Annual occupancy and isopod abundance in at least three, natural habitat sites (that is, the natural "Evergreen" system, and two artificial habitat sites including the North

Unit, and the South Unit of the Socorro Isopod Propagation Facility). All three natural habitat sites must have pools containing diverse physical structure or vegetation sufficient to provide for all life functions of the Socorro Isopod. These natural 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 a permanent conservation easement or covenant that commits present and future landowners to the conservation of Socorro Isopod, such that the species no longer no longer meets the definition of an endangered or threatened species and may be delisted.

Justification: 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 the species resilience, representation, and redundancy.

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 population and are statistically undisguisable from those measured in the natural Socorro Isopod population until all necessary genetic maintenance practices are standardized and implemented for the captive population.

Justification: Long-term species management of a genetically diverse captive population, which is monitored and managed to be indistinguishable from the natural population, 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. 2002).

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 isopods are fluctuating within expected levels and that a genetically diverse captive population is 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 ESA (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. 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 Socorro Isopod. 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 Isopods 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). In the natural population, juvenile isopods (called 'mancas') 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 physical structure provided by rocks and vegetation provides 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 Socorro Isopod 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 the species resilience, representation, and redundancy. Long-term management of these three habitat 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 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 its natural habitat, in two additional artificial habitats, and in a captive population 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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