Thermosphaeroma thermophilium (Socorro Isopod)

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Taxonomy

- **Class**: MALACOSTRACA
- **Order**: CRUSTACEA
- **Family**: SPHAEROMATIDAE
- **Genus**: Thermosphaeroma
- **Scientific Name**: *Thermosphaeroma thermophilium* (Richardson, 1897)
- **Common Name**: Socorro Isopod
- **Synonyms**:
- **Taxonomic Name Source**:McLaughlin, P. A., D. K. Camp, M. V. Angel, E. L. Bousfield, P. Brunel, R. C. Brusca, D. Cadien, A. C. Cohen, K. Conlan, L. G. Eldredge, D. L. Felder, J. W. Goy, T. Haney, B. Hann, R. W. Heard, E. A. Hendrycks, H. H. Hobbs III, J. R. Holsinger, B. Kensley, D. R. Laubitz, S. E. LeCroy, R. Lemaitre, R. F. Maddocks, J. W. Martin, P. Mikkelsen, E. Nelson, W. A. Newman, R. M. Overstreet, W. J. Poly, W. W. Price, J. W. Reid, A. Robertson, D. C. Rogers, A. Ross, M. Schotte, F. Schram, C. Shih, L. Watling, G. D. F. Wilson, and D. D. Turgeon. 2005. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31. 545 pp.

Agency Status

- **NMDGF**:
- **Federal Status**:
- **BLM Sensitive**:
- **USFS**:
- **IUCN Red List**: Extinct in the Wild
- **Nature Serve Global**: G1
- **NHNM State**: S1
- **NM Endemic**:YES

Description

The Socorro Isopod has an oblong-ovate, flattened body with almost parallel sides. It is smooth and greyish brown in color, with small black spots and lines throughout. These markings converge forming a broad, black band in the center

of each thoractic segment (Richardson 1898). All the exposed edges of the body are tinged with bright orange, with some specimens having more extansive orange coloration than others. It has seven pairs of legs, two sets of antenna on the head, and uropods, or an oar-like extension on the last abdominal segment). Males range in length from 4-13 mm and females are slightly smaller, ranging from 4.5-6 mm (USFWS 1982).

Habitat and Ecology

The Socorro Isopod is a freshwater species whose only known native habitat, near Sedillo Spring, has been destroyed. The characteristics of the original habitat are unknown, as habitat details were not given at the time of description (Richardson 1898) and the habitat was destroyed shortly thereafter. The Isopod now occurs in a heavily modified environment at the outflow of the spring. Sedillo Spring is a warm spring with water temperatures ranging between 31 and 32^{o}C (USFWS 1982). The currently occupied habitat, referred to as the "native" habitat, consists of a narrow (15–90 cm), shallow (0.5–15 cm) stream with an oval-shaped, concrete pool (0.9 by 2.7 by 0.2 m), located in the upper third of the spring brook. Upstream of this pool is the valve site where groundwater discharges. This area consists of lotic habitat in a small run (0.24 by 0.75 m) with sandy substrate. Water then flows downstream from the valve site along a 10 m buried pipe and discharges to a concrete pool, known as the pool site. Higher abundance of isopods can be found here, likely due to more lentic flows and greater cover, including deep aqueous silt, rocks, and the presence of an emergent monocot (*Distichlis* sp.). Outflow from the pool is channelized into an open pipe, 30 m long, that has filled with sand, gravel, and woody debris. This site is referred to as the run site and is characterized by broad, shallow flows interspersed within the channelized spring run (Lang *et al*. 2006). Since 1988, the species has also been housed at the Socorro Isopod Propagation Facility (SIPF), a captive outdoor habitat built in close proximity to Sedillo Spring. This artificial habitats consists of two separate but adjacent "Units", or runs, each containing a series of four pools (0.53 by 1.63 by 0.75 m) connected by PVC pipe. Water from Sedillo Spring runs through the pools at a rate of 0.02 m^3/min (Lang *et al.* 2006).

Socorro Isopods are omnivores; their primary food source is algae, which covers the substrate of their habitat, but detritus and dragonfly nymphs are also consumed (Shuster 1977, USFWS 1982, NMDGF 2018). Females and juveniles seem to prefer feeding on vegetation, likely as it provides shelter from predators; males prefer bottom sediments (Jormalainen and Shuster 1997, USFWS 2018). Males have been observed feeding in clusters, feeding on injured or incapacitated animals (NMDGF 2018). Additionally, there are records of the Isopod engaging in cannibalism (Shuster 1977, Bleakley *et al*. 2013). Isopods appear to primarily attack injured individuals and cannibalistic behavior almost always involves numerous predatory individuals (Shuster 1977). Socorro Isopods seem to be primarily nocturnal; they are minimally active during the day and activity increases in the late afternoon, reaching its peak about an hour before sunset. Activity level remains high until dawn (Shuster 1977).

In captivity, Shuster (1977) reported a positive correlation between female size and fecundity, with larger, longer lived females producing up to three broods of 6-20 neonates (Lang et al. 2006). Shuster (1977) also found the average brood ranges from three to 57 individuals. Females reproduce year round, with reproductive peaks in the spring and fall (Lang *et al*. 2006). Juveniles reach sexual maturity in six to eight weeks, with males maturing more rapidly (Shuster 1981a). Individual longevity is about one year (Shuster 1979). Males engage in precopulatory guarding, preferring to mate with larger, more fecund females (Shuster 1981b).

Geographic Range:

The Socorro Isopod is known only from the thermal outflow of Sedillo Spring, located approximately 3 km west of the City of Socorro, in Socorro County, New Mexico. The spring habitat was altered in the early 1900s to support a bathhouse, referred to as "The Evergreen", which was subsequently abandoned (Shuster 1981a). The water system is

now a small, cement lined animal watering tank, a smaller pool, and about 40 meters of open irrigation pipe (USFWS 1982). In total, the Isopod occurs throughout the entire 50 m reach of the spring system (Lang *et al*. 2006).

In August of 1988, this altered native habitat dried up when spring discharge was diminished, leading to a likely extinction event of the Socorro Isopod in the wild. The native population was augmented a month later with captive individuals from the University of New Mexico. This near extinction event prompted the development of the Socorro Isopod Propagation Facility (SIPF), which was built in 1990, within one km of the native habitat (NMDGF 2018). This facility hosts two separate populations. There is also a captive population is housed at the Albuquerque BioPark.

The majority of the water from Sedillo Spring is diverted for municipal use by the City of Socorro. There are two other historical springs in proximity to Sedillo Spring, Cook and Socorro Springs, both of which have also been capped and diverted for use by the City of Socorro. These three springs once collectively fed a large marsh, extending half a mile to the east of Cook Spring. The marsh is now dry, but it is possible the Socorro Isopod once occurred at the outflow of all three of these spring systems (Shuster 1977).

Conservation Considerations:

The Socorro Isopod has been the target of many conservation actions since the 1970s. Due to small population numbers, a restricted range, and reduced habitat, the species was listed as Endangered by the United States Fish and Wildlife Service (USFWS) in March of 1978 and as Endangered by the State of New Mexico in February of 1978 (USFWS 1978). Therefore, both the USFWS and the New Mexico Department of Game and Fish work collectively to actively manage the species, including population and habitat monitoring and habitat protection.

A recovery plan was published in 1982, with the primary objectives of preventing extinction of the species by stabilizing and enhancing the native habitat and to initiate recovery by maintaining captive populations. As a result, three captive populations, one at the University of New Mexico, one at the Rio Grande Zoo (now the Albuquerque BioPark) and one at Dexter National Fish Hatchery were established (USFWS 1982). Today, only the captive population at the Aquatic Conservation Facility of the Albuquerque BioPark remains. Two additional captive populations have been secured at the Socorro Isopod Propagation Facility (SIPF). The SIPF was developed in 1990 after the native population nearly went extinct, to establish a more secure habitat for the species as well as to conduct captive propagation, genetic, and life history studies (NMDGF 2018). It is in close proximity to Sedillo Spring, and water is diverted from the spring to supply two concrete tank systems, known as the North and South Units, which each support a separate population of the Isopod. There is likely no gene flow between the North and South Units at SIPF, and there is no geneflow between the two populations at the SIPF and the native population at Sedillo Spring (USFWS 2019).

An updated recovery plan was published in 2019 (USFWS 2019), which highlights the need for monitoring and genetic work to ensure the health of all Socorro Isopod populations. A genetic management plan was developed in 2022 (NMDGF 2022, Appendix 2) and results from recent genetic studies have revealed that all three populations (Sedillo Spring, SIPF, and Albuquerque BioPark) are similar genetically, though some enhancement of the BioPark population is needed (Jones and Berg 2020, NMDGF 2022, NMDGF 2024). Therefore, in 2024, the captive population at the BioPark was augmented by individuals from the SIPF (P. Horley pers. obs. 2024). In addition to genetic research, biologists from NMDGF and USFWS have been working with the City of Socorro to maintain proper drainage at the SIPF. Pipes have become occluded, likely by tree roots, and must be cleared (NMDGF 2021). They also plan to install structure within the artificial habitats, in the form of rocks and artificial plants, in order to more closely mimic natural habitat conditions and reduce the incidence of cannibalistic behavior (USFWS 2022). In experimental trials, habitats with more vertical structure have been shown to support populations with increased variety of age classes, suggesting

it is important for long-term viability of populations in captivity (Lang *et al*. 2006). Additional conservation needs include land protections for the population at Sedillo Spring. The site is on private property, so options for protection may include conservation easements, acquisition by USFWS, or other agreements (USFWS 2022).

Population and habitat monitoring at the native spring and at the SIPF has occurred regularly since November of 1994 (NMDGF 2018). The population at Sedillo Spring was last surveyed in 2020 (USFWS 2022, NMDGF 2024).

Threats:

Historically the main threat to this species was destruction and modification of habitat. Over the past few centuries, Sedillo Spring and other thermal springs along the Socorro Mountains, have been altered by municipal and private development projects, and spring flows across the system have either been intercepted at the surface or capped off (USFWS 1978). This has resulted in the entire loss of the original habitat occupied by the Socorro Isopod. The Isopod remains extant in a modified environment where the surface waters from Sedillo Spring now flow.

Currently, the main threat to this species is the disruption of water flow at Sedillo Spring. In 1988, this species may have become extinct in the wild when diminished discharge of the native spring resulted in habitat desiccation (NMDGF 2018). The cause of this diminished discharge is not well understood, with some suggesting vandals broke a valve controlling the water supply (B. Lang, pers. comm. in Jormalainen *et al.* 2019) and other suggesting drought was the culprit (USFWS 2022). Moving forward, drought is a major concern, as droughts are projected to become more prolonged, severe, and common in the region under future climate change scenarios (USGCRP 2018). Disruption to thermal groundwater discharge may also result from over-pumping of the groundwater aquifer (NMDGF 2018). Tree roots have also been responsible for causing the Sedillo Spring habitat to run dry. In 1998, tree roots blocked the pipes from Sedillo Spring, causing extensive losses of Isopods (NMDGF 2001).

Additionally, mining, U.S. Department of Defense (DOD) activities, and vandalism may pose a threat to the species. The area around Socorro contains large perlite ore repositories. This may be a concern for the Isopod if mining threatens the long-term stability of the thermal area. Surface or sub-surface explosive tests on neighboring lands due to perlite mining or DOD practices could fracture bedrock formations, causing mixing of deep, thermal waters, with shallow, non-thermal groundwater. Any resulting changes to the physiochemical properties of the water at Sedillo Spring could compromise both the Sedillo Spring population and the SIPF populations (NMDGF 2002a). Vandalism is another concern for this species. Between 1995 and 2002, there were several incidents, including the of removal of a valve controlling culvert flow, removal of concrete wall in the spring, dumping a car near the spring, and removal of vegetation from the Socorro Isopod Propagation Facility (SIPF) (NMDGF 2002b, 2004).

The survival of this species also relies on captive breeding programs, yet differences in population structure between native and captive populations has arisen. Selection towards larger individuals in the captive populations, possibly due to cannibalism, has resulted in unexpected genetic and morphological diversity in the population (Lang *et al*. 2012). Other concerns regarding the captive populations include algae infestations, which hampered successful propagation of isopods inhabiting pools of the SIPF in the past (NMDGF 1996). In 1995, the water temperature from Sedillo Spring cooled, and Isopods were extirpated from the South Unit of the SIPF (NMDGF 2001). In 1999, a contamination event in the North Unit of the SIPF caused the population to extirpate (Lang *et al*. 2006). In 2020, root growth in the outflow of the SIPF caused water to back up, allowing dragon fly larvae to colonize the South Unit pools and predate on the isopods (NMDGF 2021, USFWS 2022).

Population:

The population size and trend of this species have been monitored closely since at least the 1970s. In 1976 and 1977 the population size at the Sedillo Spring bathhouse was reported to be around 2,400 and 2,449 total individuals, respectively (Hatch 1976, Shuster 1977). In August 1988, the population at Sedillo Spring likely extinct due to diminished spring flows, which cause the habitat to dry up (Lang *et al*. 2006). The species was subsequently classified as Extinct in the Wild on the 1996 IUCN Red List of Threatened Species (Inland Water Crustacean Specialist Group 1996). When flow was re-established in September of that year, captive-bred individuals from the University of New Mexico were introduced to the spring. Some have theorized that Isopods may have survived the drying event, and were flushed from the underground plumbing when flows returned (Lang *et al*. 2006). However, an extirpation event such as this one would have created a genetic bottleneck. Such a bottleneck has been confirmed by recent genetic studies showing a lack of diversity between the three populations (Jones and Berg 2022). As a result of this incident, controlled propagation of isopods commenced in 1990 at the nearby Socorro Isopod Propagation Facility (SIPF) (Lang *et al*. 2006).

Subsequently, population and habitat monitoring of this species at the SIPF and at the "native" Sedillo Spring habitat has occurred regularly since November of 1994 (NMDGF 2018). In 2012 and 2013 populations were sampled monthly (NMDGF 2013). Annual surveys were then done in 2015 and 2016 (NMDGF 2016), and from 2019 to 2022, populations were sampled biannually. Populations have reportedly stayed stable throughout this time (USFWS 2022).

The population at the "native" Sedillo Spring habitat was last surveyed in 2020, and the density of Isopods was found to be 3,040 isopods per m^3 (NMDGF 2021a). The Sedillo Spring population occupies an area of 50 m, though isopods are primarily found in one chamber that measures 0.9 by 2.7 by 0.2 m (Lang *et al*. 2006, USFWS 2022). It is unclear if the count represents an average across the total area, or an estimate at the primary chamber where densities are higher. Therefore, an estimated number of individuals cannot be calculated. At the SIPF, the density of isopods at last count in the North Unit averaged 333 isopods/m^3 and the density in the South Unit measured just 42 isopods/m^3 (NMDGF 2021). Both the North and South Units have four tanks with dimensions of 0.53 by 1.63 by 0.75 m, for a total volume of 2.59 m^3. Therefore, there were an estimated 863 isopods in the North Unit and 109 in the South Unit. Additionally there is a captive population with an unknown number of individuals at the Albuquerque BioPark. In 2024, this captive population was augmented with 80 individuals from the SIPF to ensure genetic diversity in the captive stock. Twenty-five individuals were used to start a new tank, 10 were added to each of four existing 15-gallon tanks, and 20 were added to an existing 20 gallon tank (P. Horley pers. obs. 2024).

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More Information