U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Heterelmis stephani

Common Name:

Stephan's Riffle beetle

Lead region:

Region 2 (Southwest Region)

Information current as of:

02/05/2013

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Arizona
- **US Counties**:County information not available
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Arizona
- **US Counties**: Santa Cruz, AZ
- **Countries**: United States

Land Ownership:

The entire range of this species is believed to be confined to Madera Canyon in the Coronado National Forest. We estimate 5 acres (2 hectares) of habitat on the Coronado National Forest.

Lead Region Contact:

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Lead Field Office Contact:

AZ ESFO, David Smith, 928-226-0614 x109, david_r_smith@fws.gov

Biological Information

Species Description:

Beetles are the largest order of insects with more than 300,000 described species, almost a third of all known animals (Brusca and Brusca 1990, p. 551). Stephans riffle beetle (Heterelmis stephani) was fully described by Brown (1972a, pp. 230-234). In general, the species length is 2.32.6 millimeters (mm) (0.09-0.1 inches (in.)) and breadth is 1.051.20 mm (0.04-0.05 in).

Taxonomy:

Stephans riffle beetle is a member of the family Elmidae (Phylum Arthropoda; Class Insecta; Order Coleoptera). It was originally identified by Brown (1972a, pp. 230-234) from 71 specimens collected from Madera Canyon in the Santa Rita Mountains, Santa Cruz County, Arizona. Its validity as a taxon was confirmed by Brown (1983, p. 5) and Bosse et al. (1988, p. 199). Thus, we have carefully reviewed the available taxonomic information to reach the conclusion that H. stephani is a valid taxon.

Habitat/Life History:

Beetles of the family Elmidae gain their common name riffle beetle from their propensity to be found living in shallow streams, rapids, or other comparable flowing waters. The springs can be described as a typical isolated, mid-elevational, permanently saturated, spring-fed aquatic climax community that is commonly referred to as a ciénega (Hendrickson and Minckley 1984, pp. 133-134, p. 169). Elmid larvae are strictly aquatic and respiration occurs through gills (Brown 1983, p. 1). Riffle beetles attach their eggs to the underside of submerged rocks, woody debris, or aquatic plants (Brown 1987, p. 254). Life histories of elmids are quite variable with a short incubation period and a larval stage lasting from 6 to 36 months (Tavares and Williams 1990, p. 564).

Upon reaching maturity, riffle beetle larvae crawl out of the aquatic environment to pupate under cover of sand, rock, bark, or other debris (Brown 1972b, p. 1; Brown 1983, pp. 1-2). In temperate zones, pupation typically requires 1-2 weeks and occurs from late spring through summer (Brown 1987, p. 255). After emergence, adults commonly fly and may be attracted to lights during their sole dispersal flight (Brown 1983, p. 2; Brown 1987, p. 255). Adults are small, typically less than 3 mm (0.12 in) in total length (Brown 1983, p. 2). Upon reentering the aquatic environment, most adult riffle beetles never again leave the water (Brown 1987, p. 256; Brown 1972b, p. 1). Respiration for adults occurs through the use of a plastron (a semi-permanent bubble of air through which respiratory gases is exchanged in some aquatic invertebrates) (Brown 1972b, pp. 1-2). Riffle beetle diet consists of microorganisms and debris, such as diatoms and detritus, scraped from substrate surfaces (Brown 1987, p. 262; Tavares and Williams 1990, p. 564).

An interesting and important fact about riffle beetle biology is that these organisms are suspected of possessing some sort of chemical defense that readily repels diverse types of predators (Brown 1987, p. 264). There are also accounts of indigenous peoples of Lima, Peru, who use beetles of the elmid family as a food seasoning (Brown 1987, p. 264). The potential medicinal value of elmids has not been explored.

Based on our current knowledge, primary constituent elements appear to include: 1) permanent free-flowing springs; 2) shallow, unpolluted water; 3) coarse firm substrates such as pebble, gravel, cobble, and woody debris; and 4) native aquatic macrophytes, algae, and periphyton.

Historical Range/Distribution:

Stephans riffle beetle is an endemic riffle beetle found in isolated spring environments within the Santa Rita Mountains, Santa Cruz County, Arizona. Based on relatively intensive surveys, the entire range of this species was believed to be confined to Madera Canyon on the Coronado National Forest (Barr and Shepard 1993, p. 1, Arizona Game and Fish Department 2002, p. 1). Historically, only three populations have been documented, including Bog Springs, Sylvester Spring, and in seepage from a water tank filled with water diverted from Bog Springs.

Current Range Distribution:

Currently, the species is known only from Sylvester Spring on the Coronado National Forest (Barr and Shepard 1993, p. 24). During field investigation in 2005, United States Forest Service (USFS) personnel confirmed that Sylvester Spring was still flowing and providing suitable habitat conditions for the beetle (USFS 2005, p. 8-9). Although they did not conduct beetle surveys, the confirmation of flowing water indicates that conditions conducive to survival of the species remain intact. The population in the seepage from Bog Springs has been extirpated since water ceased flowing from the water tank in 1976.

Population Estimates/Status:

Information is not available on Stephans riffle beetle population sizes. However, other species within the Genus Heterelmis can exist in very large densities. Martinez and Sorensen (2007, p. 30) found Heterelmis sp. populations as high as 1,328 individuals within a spring system as small as 2.055 square meters (m2) (22.12 square feet (ft2)) in central Arizona. While Barr and Shepard (1993, p. 24-25) only collected Stephans riffle beetle at Sylvester Spring, they found habitat suitable to support the more widespread species, Heterelmis obesa, at several other sampled springs. In addition, two other riffle beetle species, Zaitzevia parvula and Microcylloepus similis were collected at sampled sites (Barr and Shepard 1993, p. 45-47). They concluded that other Stephans riffle beetle populations may exist in more remote springs that were not surveyed (Barr and Shepard 1993, p. 25).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Sylvester Spring, where Stephans riffle beetle was last found, is not totally in its natural condition. The spring source is fenced, while flow is piped outside to a spring box which overflows. All described springs in Madera Canyon have been similarly developed in this fashion, although Sylvester Spring is the only one fenced (Barr 1991, p. 2). Concrete boxes were constructed below the spring heads by the Civilian Conservation Corps in the 1930s (Barr and Shepard 1993, p. 9). Many of these springs are primary water sources for the private residences in Madera Canyon. The most significant habitat loss occurred after the species was originally described. The type locality, where the species was originally collected, no longer exists as habitat, as determined by Barr and Shepard (1993, p. 18). Barr and Shepard (1993, p. 11) found only one adult Stephans riffle beetle in Sylvester Spring in 1993. Stephans riffle beetle was not found in Bog Springs proper (Barr and Shepard 1993, p. 9). Based on the 71 beetle specimens originally collected in 1969 it appears the species was once very common, but since 1993 it has become rare (Barr and Shepard 1993, p. 24). Habitat loss at the type locality represents a loss of a significant portion of the known range of Stephans riffle beetle.

In summary, the Stephans riffle beetle may or may not be threatened by habitat loss and modification from past spring alteration. In comparison to other riffle beetle species, Stephans riffle beetle is unique because the areas it normally occupies dried up each year (Brown 1972a, p. 234). Spring habitat continues to be present in Madera Canyon, and continues to support other riffle beetle species. In 1993, although numerous specimens from three other riffle beetle species were collected, only one adult Stephans riffle beetle was

collected (Barr and Shepard 1993, pp. 45-47). In May 2012, U.S. Fish and Wildlife Service (Service) staff collected numerous as-yet-unidentified riffle beetles from six springs in Madera Canyon. Two springs, Armour and Florida, were sampled in September 2012. These two high-elevation springs are located in Florida Canyon which is adjacent to Madera Canyon. These springs were not sampled by Barr and Shephard (1993). Additional samples were collected from flowing portions of Madera Canyon in November 2012. Information from these collection efforts will help to further determine how modification of habitat affects this species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Stephans riffle beetle has been subjected to a limited number of scientific studies aimed at determining taxonomy and distribution. The species is not utilized for commercial or recreational purposes. Therefore, this is not known to be a factor threatening the Stephans riffle beetle.

C. Disease or predation:

We have no information regarding disease or predation for the Stephans riffle beetle. This is not known to be a factor threatening the Stephans riffle beetle.

D. The inadequacy of existing regulatory mechanisms:

There is no State or local government programs structured to address the conservation of rare and imperiled insects. The Arizona Department of Agriculture, having jurisdiction over insects, does not currently have an insect conservation program. This species is not identified in a State Wildlife Action Plan as the Arizona Game and Fish Department does not have jurisdiction over insects. Thus, there are no existing regulatory mechanisms that are designed to address the threats to this species.

E. Other natural or manmade factors affecting its continued existence:

Endemic spring-dependent organisms whose populations exhibit a high degree of geographic isolation can be extremely susceptible to stochastic extinction resulting from catastrophic natural disasters such as fires, floods, or changes in spring water chemistry.

The direct effects of fire on aquatic macroinvertebrate communities generally are minor or indiscernible (Rinne 1996, p. 655; Minshall 2003, p. 155). Instead, adverse effects of wildfire on stream macroinvertebrates are largely the result of physical changes in habitat due to increased runoff after the fire (Minshall et al. 1989, p. 712). Wildfires have occurred in the past within Madera Canyon. The Florida Fire burned over 23,000 acres of Florida Canyon and the upper reaches of Madera Canyon near Mount Wrightson in July 2005. The Service did not observe any indication that post-fire flooding had any effects to the Madera Canyon springs that were sampled in May 2012. Therefore we conclude that wildfires are not threatening this species at this time. In addition to wildfires, streams in arid environments are subjected to extreme variable seasonal changes in water flow, temperature and chemistry during flood flows and droughts (Bogan and Lytle 2007, p. 291). It is these variations in flow that support higher aquatic insect species diversity than in neighboring streams with relatively constant flow (Dieterich and Anderson 2000 In Bogan and Lytle 2007, p. 299). While the springs in the sampled area are located in steep canyons which would be expected to have high flows during the summer thunderstorm season or periods of snowmelt, four of the springs (Sylvester, Kent, McBeth, and Bellows) are located on the hillsides above the channel. Sprung Spring is located high in the headwaters where there is little watershed to generate large flood flows. It is also well-armored with large boulders that would provide protection during floods. Bog Springs, while located in the canyon bottom did not show evidence of being impacted by floods. Therefore, we conclude that flooding, resulting from thunderstorms or post-fire runoff is not a factor affecting this species at this time.

Drought in the Southwest is not uncommon; however, the frequency and duration of dry periods may be altered by climate change. Global climate change and associated effects on regional climatic regimes, is not well understood, but the predictions for the Southwest indicate less overall precipitation and longer periods of drought. Seager et al. (2007, p. 1181) predict, based on broad consensus among 19 climate models, that the Southwest will dry in the 21st century and that the transition to this drier state is already underway. The increased aridity associated with the current on-going drought, and the 1950s drought will become the norm for the American Southwest within a timeframe of years to decades, if the models are correct. Perhaps this species, along with its habitat, may eventually be affected in some manner by climate change, but the magnitude and extent of possible change cannot be verified or quantified at this time.

None of the Madera Canyon springs that were sampled are located within a canyon with permanent flowing headwaters. Riffle beetles in these systems may be able to burrow into the gravel channel bottom during period of low or no flow (Brown 1972a, p. 234; Brown 1978, p. 263). Many enter a period of diapause (egg or larval period that the insect does not develop until more suitable conditions return for growth) in the hyphoriec zone (channel bottom material) until high flows return (Bogan and Lytle 2007, p. 301). These adaptations may allow Stephans riffle beetle to persist during long drought periods that may occur in the future. Therefore, we conclude that Stephans riffle beetle is not significantly threatened by drought.

We conclude that the best scientific and commercial information available indicates that natural or anthropogenic factors are not threatening the Stephans riffle beetle, or that these factors are acting cumulatively with other potential threats.

Conservation Measures Planned or Implemented :

The Service has informally contacted the USFS to develop a candidate conservation agreement. The Service re-surveyed the springs within Madera Canyon surveyed by Barr and Shepards (1993) in May 2012. In addition the Service also surveyed Sprung and Bellows springs in Madera Canyon and McBeth Spring in an adjacent drainage in May 2012. The Service is currently sorting collected sediment and debris samples for riffle beetles.

Summary of Threats :

Based on our current information, Stephans riffle beetles may be threatened by degradation or modification of habitat. While Service surveys in May 2012 found many riffle beetles at numerous springs in Madera Canyon and an adjacent drainage, sample processing has not been completed to allow specimens to be sent to authorities for species determination. It is unclear, despite the rarity of Stephans riffle beetle, how potential habitat loss, modification, or degradation is affecting this species. Information from the 2012 survey should provide additional information to make this determination in next years assessment of this species.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

The documented loss of habitat and extirpation of a population of Stephans riffle beetle demonstrates the need to develop a conservation program in coordination with the USFS. Therefore the following conservation measures have been identified: confirm continued persistence, evaluate current distribution, assess habitat needs, and develop and implement conservation measures in coordination with the USFS and academia.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-imminent	Monotypic genus	10
		Species	**11**
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

We changed the listing priority number (LPN) from 8 to 11, in 2012 to reflect the lack of information on imminent threats. Despite the rarity of Stephans riffle beetle in Madera Canyon, springs that have been developed and used since the 1930s continue to support other riffle beetle species. We cannot ascertain that habitat alteration is negatively affecting Stephans riffle beetle at this time. The 2012 survey should provide additional information for this determination. No change has been made in the LPN number since 2012.

Magnitude:

All known locations for Stephans riffle beetle have been modified in some manner, though 2005 and 2012 site visits found that Sylvester Spring continues to provide suitable habitat conditions. The type locality has been entirely dewatered resulting in localized extirpation, though that site was man-made habitat. We do not know the biological significance of these threats or how they affect the entire range of the species. However, analyzed survey data are 19 years old and we will not have current information indicating whether the species is extinct or extant until Service 2012 samples are completely analyzed. Therefore, we conclude the overall magnitude of threats is low.

Imminence :

Most of the species habitat is currently maintained in modified conditions. However, to our knowledge, the USFS has no specific plans to further modify or restore habitats. Therefore, we conclude that the threats to this species are non-imminent.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

The U.S. Forest Service has no current plans to modify remaining habitat.

Description of Monitoring:

The first Stephans riffle beetle surveys were completed 19 years ago by Barr and Shepard (1993). These were the most recent surveys for the species where specimens were identified to the species level. The USFS field investigations have revealed the persistence of suitable habitat in 2005. The Service surveyed six spring sites in 2012. These samples have not been completely analyzed. When updated information is available, we will re-evaluate the magnitude and immediacy of threats to this species.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

Arizona

State Coordination:

See discussion above on Inadequacy of Existing Regulatory Mechanisms and the states ability to participate in management of invertebrate species.

Literature Cited:

Barr, C.B. 1991. Personal letter to Robert A. Johnson regarding the distribution and status of Heterelmis stephani, dated December 19, 1991. 2 pp.

Barr, C.B., and W.D. Shepard. 1993. Survey for Heterelmis stephani Brown (Insecta: Coleoptera: Elmidae) in Madera Canyon and other localities in the Santa Rita Mountains, Arizona. Final Report prepared for U.S. Forest Service. 48 pp. August 14, 1993.

Bogan, M.T. and D.A. Lytle. 2007. Seasonal flow variation allows time-sharing by disparate aquatic insect communities in montane desert streams. Freshwater Biology 52:290-304.

Bosse, L.S., D.W. Tuff, H.P. Brown. 1988. A new species of Heterelmis from Texas (Coleoptera: Elimdae). The Southwestern Naturalist. 33(2):199-203.

Brown, H.P. 1972a. Synopsis of the genus Heterelmis Sharp in the United States, with a description of a new species from Arizona (Coleoptera, Dryopoidea, Elmidae). Entomological News. 83: 229-238.

Brown, H.P. 1972b. Biota of freshwater ecosystems. Identification Manual No. 6. Aquatic Dryopoid beetles (Coleoptera) of the United States. Prepared by H.P. Brown, University of Oklahoma for the Environmental Protection Agency. April 1972.

Brown. H.P. 1983. A catalog of the Coleloptera of America north of Mexico. Family: Elmidae. United States Department of Agriculture. Agriculture Handbook Number 529-50. Prepared by Agricultural Research Service. November 1983. 21 pp.

Brown, H.P. 1987. Biology of riffle beetles. Annual Review of Entomology. 32: 253-73.

Dieterich, M. and N.H. Anderson. 2000. The invertebrate fauna of summer-dry streams in western Oregon. Archiv fuer Hydrobiologie, 147:273-295.

Martinez, M.A., and J.A. Sorensen. 2007. Effect of Sampling Without Replacement on Isolated Populations of Endemic Aquatic Invertebrates in Central Arizona. Journal of the Arizona-Nevada Academy of Science. 39(1):28-32.

Minshall, G.W. 2003. Response of stream benthic macroinvertebrates to fire. Forest Ecology and Management 178:155-161.

Minshall, G.W., J.T. Brock, and J.D. Varley. 1989. Wildfires and Yellowstones stream ecosystems. BioScience 39:707-715.

Rinne, J.H. 1996. Short-term effects of wildfire on fishes and aquatic macroinvertebrates in the southwestern United States. North American Journal of Fisheries Management 16:653-658.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Liu, G. Vecchi, H. Huang, N. Harnik, A. Leetma, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in Southwestern North America. Science 316: 1181-1184.

Tavares, A.F., and D.D. Williams. 1990. Life histories, diet, and niche overlap of three sympatric species of Elmidae (Coleoptera) in a temperate stream. Canadian Journal of Entomology. 122: 563-577.

U.S. Forest Service. 2005. Burned Area Emergency Response Plan, Florida Fire, Wildlife Resources Assessment. Prepared by Debbie Sebesta, Nogales District Wildlife Biologist, Coronado National Forest. 11 pp.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Jay E. Nicholopoulos 06/19/2013
Date

Concur: 10/28/2013
Date

Did not concur: _____ _____
Date

Director's Remarks: