2026 • Vol. 1 • pp. x–xx • REPORT

EARLY VIEW ARTICLE

Journal of Lost Species

The Bonito diving beetle (*Mystonectes neomexicanus*): always rare and currently lost without observations since 1976

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Abstract: The Bonito diving beetle, *Mystonectes neomexicanus*, is a predacious diving beetle (Coleoptera: Dytiscidae) known from the Sacramento Mountains and the Rio Hondo in New Mexico, Brewster, and Presidio Counties in Texas, and Chihuahua, Mexico. The species has been recognized as rare and potentially threatened since 1991. Since then, it has been designated as a Federal Species of Concern in the United States, a Forest Service Sensitive Species, a Bureau of Land Management Sensitive Species, and a Species of Conservation Concern within the Lincoln National Forest in New Mexico. It has been over fifty years since the last known collection of this species and several recent attempts to rediscover the species at the type locality have been unsuccessful. As a result, the species is currently considered lost.

Keywords: Diving beetles, New Mexico, Mexico, Texas, aquatic insects, Coleoptera

Conservation statement: Little is known about the rarely-collected Bonito diving beetle (Coleoptera: Dytsicidae), and efforts are needed to investigate its distribution, life history, and population size and trends so that its conservation status can be determined. Conservation organizations and land managers should facilitate these efforts by coordinating with knowledgeable scientists. Until this research is advanced it will be difficult to determine any needed protections. Importantly, it is not known whether the species is still extant. Additional search effort is needed to determine presence at or near sites where it was originally collected, characterize habitat, and better understand the biology of the species. Collecting efforts are recommended in streams and other habitats in the Sacramento Mountains; near sites the species has been collected in southeastern New Mexico, southwestern Texas, and Mexico; and in comparable habitats in the Chiricahua Desert region.

Resumen: El escarabajo acuático Bonito, *Mystonectes neomexicanus* (Coleoptera: Dytiscidae), un escarabajo acuático depredador, registrado en las montañas de Sacramento y el río Hondo en Nuevo México, así como en los condados de Brewster y Presidio en Texas, así como en Chihuahua, México. Esta especie ha sido reconocida como rara y potencialmente amenazada desde 1991. Desde entonces, ha sido designada como Especie de Interés Federal en los Estados Unidos, Especie Sensible por el U.S. Forest Service, Especie Sensible por el Bureau of Land Management y Especie de Interés para la Conservación dentro del Bosque Nacional Lincoln en Nuevo México. Han transcurrido más de cincuenta años desde la última vez que se recolectó un ejemplar de esta especie, y varios intentos recientes, en su localidad tipo, para redescubrirla no han tenido éxito. Por ello, la especie se considera actualmente extinta o perdida.

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Received: 10 June 2025 • Accepted: 24 January 2025 • Published: xxxxx 2026
Handling editor: Chris C. Nice

ISSN: 3070-6831
https://doi.org/10.66264/jls.v1i1.34

Palabras Clave: Escarabajos acuáticos, Nuevo México, México, Texas, insectos acuáticos, Coloptera.

Estado de conservación: Se sabe poco sobre el escarabajo buceador Bonito (Coleoptera: Dytiscidae), una especie poco representada en colecciones, por lo que es necesario investigar su distribución, ciclo de vida, tamaño poblacional y tendencias poblacionales para poder determinar su estado de conservación. Las organizaciones conservacionistas y los administradores zonales deben facilitar estos esfuerzos mediante la coordinación con expertos científicos. Hasta que esta investigación tenga avances, será complejo determinar las medidas de protección necesarias. Es importante destacar que se desconoce si la especie aún persiste en los lugares tipo. Una acción inicial prioritaria es determinar su presencia en hábitats donde se recolectó originalmente o sitios cercanos Es necesario intensificar esfuerzos de búsqueda para localizar e investigar la biología de esta especie. Se recomienda realizar muestreos en arroyos y otros hábitats en las montañas de Sacramento; cerca de los sitios donde fueron las recolecciones originales de la especie, especialmente en el sureste de Nuevo México, el suroeste de Texas y México; así como en hábitats similares en la región del desierto de Chihuahua.

INTRODUCTION

Natural history

The Bonito diving beetle, *Mystonectes neomexicanus* (Zimmerman and Smith 1975), is a small, predaceous beetle in the family Dytiscidae from deserts near the US-Mexico border, where it was previously known from approximately four streams. The beetle is mainly pale dorsally with dark fasciae or lines longitudinally along the surface of the elytra (Fig. 1, Zimmerman and Smith 1975; Zimmerman 1982). Little is known about the natural history of the species, with the only information available from the original description (Zimmerman and Smith 1975) and a subsequent paper adding new distribution records (Zimmerman 1982). Implied by the names of the collection localities (Zimmerman and Smith 1975; Zimmerman 1982), it appears that they were found in small streams or small rivers (see below). Other members of the genus *Mystonectes* occur in small lentic and lotic habitats with mineral substrates, in some cases in relatively more alkaline or saline situations than many other diving beetles can tolerate (KB Miller unpublished; Zimmerman and Smith 1975; Zimmerman 1982; Larson et al. 2000). The habitat of the type locality in the state of New Mexico, USA, is a small montane stream bordered by willow (*Salix* spp.), cot-

Figure 1. *Mystonectes neomexicanus* (Zimmerman and Smith), habitus; specimen from "Papagochic River, 10 mi W of La Junta, Chihuahua" (NMSU Arthropod Collection, Las Cruces, NM, NMSUACP 0027370). Photo credit, Mike Quinn (iNaturalist Observation #111430404). Scale bar = 1.0mm based on average size of specimens.

tonwood (*Populus* spp.), and other deciduous trees at ~1,800m elevation (Figs 2, 3). In Texas and Chihuahua, the localities of collections are indicated as creeks and rivers (Fig. 3), though no additional collecting details were provided (Zimmerman and Smith 1975; Zimmerman 1982). Species of diving beetles inhabiting highly variable environments are typically winged and capable of flight, whereas some species in more stable environments have lost the ability to fly and disperse (Jackson 1952). In the southwestern United States, where aquatic habitats are often highly variable highly variable through time, most species are capable of flight and disperse effectively. On this basis, *Mystonectes neomexicanus* is presumed to be flight-capable and able to disperse among aquatic habitats. However, the flight capacity and dispersal distances of this species have not been empirically documented.

Systematics

The Bonito diving beetle, *Mystonectes neomexicanus* (Zimmerman and Smith 1975) (formerly "Bonita" diving beetle) is a member of the small predaceous water beetles (Coleoptera: Dytiscidae: Hydroporinae). The species has been placed in numerous genera because of many changes to the classification of the tribe Hydroporini and subtribe Deronectina (the *Deronectes*-group of genera). It was originally described by Zimmerman and Smith (1975) as *Deronectes neomexicanus*. It was then placed in *Deronectes* (*Stictotarsus*) (Zimmerman 1982), then *Potamonectes* (Larson 1991), then *Stictotarsus* (the *S. duodecimpustulatus* group) (Nilsson and Angus 1992), then *Boreonectes* (Angus 2010), and finally in *Mystonectes* (Fery and Ribera 2018). *Mystonectes neomexicanus sensu* Fery and Ribera 2018 is the type species for *Mystonectes* (Fery and Ribera 2018).

Based on Fery and Ribera's (2018) phylogenetic analysis, the Bonito diving beetle was placed in a new genus, *Mystonectes* Fery and Ribera along with four other species of diving beetles from the same region in two small species groups, the *M. coelamboides*-group and the *M. neomexicanus*-group. Some of these other species (such as *M. grammicus* (Sharp 1887)) are also uncommonly collected (Zimmerman and Smith 1975; Zimmerman 1982).

Geography

The species was first found and described from "Bonita [sic] Ck, 4 mi. W of Lincoln, Lincoln Co., New Mexico," which represents the type locality (Fig. 2; Zimmerman and Smith 1975). This locality likely corresponds to the Rio Bonito at its confluence with Salazar Canyon, approximately four miles northwest of the town of Lincoln, where Forest Service Road 57 crosses the stream and provides access. Other access to the stream approximately four miles from Lincoln is either more difficult or on private land. The first specimens were collected by A.H. Smith on 6 June 1966 (Zimmerman and Smith 1975). The Rio Bonito is a small stream flowing through the northern portion of the Sacramento Mountains for approximately 71 km from about 3000 m elevation until merging with the Rio Hondo at about 1600 m elevation. The stream passes through farmland, small towns, U.S. National Forest and Bureau of Land Management (BLM) land, and through one man-made reservoir, Bonito Lake, built in 1931 and filled in 1933. Thirteen specimens were originally collected from the type locality including the holotype and 12 paratypes (Zimmerman and Smith 1975). The holotype was deposited in the United States National Collection of Insects (Smithsonian Institution) (Zimmerman and Smith 1975). The paratypes were distributed between the New Mexico State University and the University of Michigan collections (Zimmerman and Smith 1975).

At the time of description, a single additional paratype specimen was included in the species from "20 mi. S of Alpine Co., [sic] Texas" (Zimmerman and Smith 1975). Presumably this means 20 mi (32 km) south of the town of Alpine, which is in Brewster County, Texas.

This is a mountainous area of the Trans-Pecos Ecological Region of Texas with small streams, possibly similar to the Rio Bonito. Candidate streams (based on the locality data provided) are Goat Creek, Calamity Creek, and Ash Creek, though it should be noted that no specific habitat information was provided for this specimen (Zimmerman and Smith 1975) and it may not have been found in a lotic habitat. This paratype is deposited in the California Academy of Sciences collection (Zimmerman and Smith 1975).

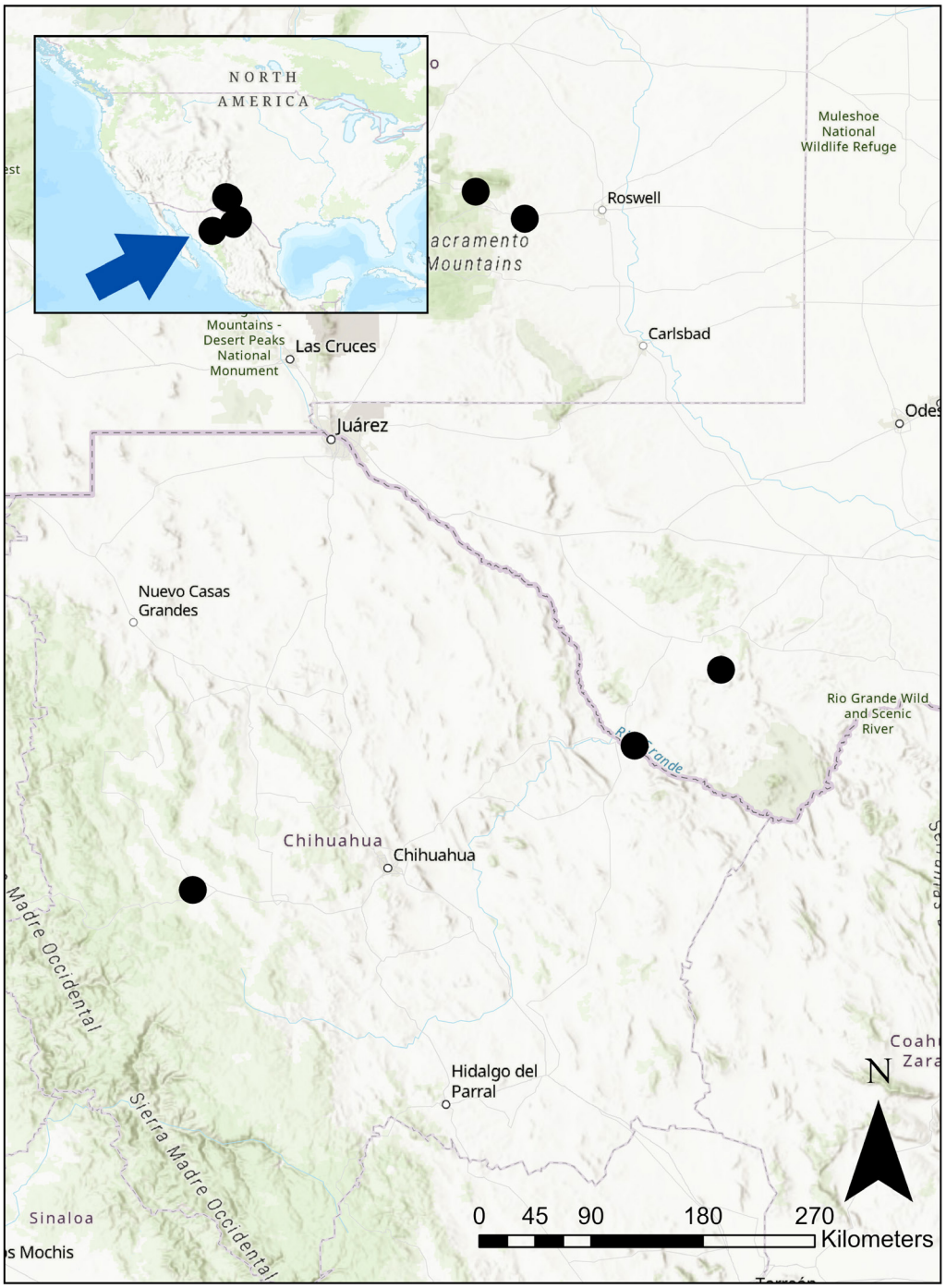

Figure 2. Map showing historical collection localities for *Mystonectes neomexicanus* (Zimmerman and Smith). Most localities are small sections of streams.

The species was later reported from additional localities by Zimmerman (1982) including "Alamito Creek near Presidio, Texas." This is likely where Texas Highway 170 crosses Alamito Creek about 8 km SW of Presidio. In the same paper, Zimmerman (1982) reported *M. neomexicanus* from "the Papagochic River, 10 mi W of La Junta, Chihuahua" (presumably the Papigochi [or Papigochic] River) without additional collection information provided.

NatureServe (2024) mentions another specimen collected in 1975 "15.5 km (6 mi.) downstream" from the type locality, but there is no published record of this specimen and no source information for this record provided.

Figure 3. Rio Bonito at or near *Mystonectes neomexicanus* presumed type locality, "Bonita [sic] Ck, 4 mi. W of Lincoln, Lincoln Co., New Mexico," 33.526646° -105.438885°; A, 13 Oct 2023. Photo credit, Miller.

No additional collection records for the species have been published since Zimmerman and Smith (1975) and Zimmerman (1982) with one possible exception by Fery and Ribera (2018). They extracted DNA from a specimen listed as *Stictotarsus neomexicanus* with the data, "Mexico, Chihuahua, Álvaro Obregón, 1975, Zimmerman" (Fery and Ribera 2018). It is not clear to what locality in Chihuahua "Álvaro Obregón" this citation is referring to. There is a small town, Rico, with the official name of "Colonia Álvaro Obregón." The town of Laguna Jaco is also known as "Álvaro Obregón." Finally, there is also a town in Chihuahua named Ejido Álvaro Obregón. However, Zimmerman and Smith (1975) and Zimmerman (1982) do not cite *M. neomexicanus* from "Álvaro Obregón," but Zimmerman (1982) does cite *M. grammicus* (Sharp) from there. Fery and Ribera (2018) sequenced a portion of Histone 3 DNA (voucher IBE-RA775, European Nucleotide Archive accession LS453158) from this specimen for a phylogenetic analysis of the subtribe. They did not include specimens of *M. grammicus* in their analysis, unless the specimen they included from Chihuahua was, indeed, *M. grammicus* and not *M. neomexicanus*, as suggested by the locality. It may be the case that Fery and Ribera (2018) misidentified *M. grammicus* as *M. neomexicanus*. Further supporting this, they found the male median lobe of the aedeagus of their specimen to not be sinuate in ventral aspect (Fery and Ribera 2018), possibly more like *M. grammicus* (Zimmerman and Smith 1975; Zimmerman 1982). However, their photos of specimens of both *M. grammicus* and *M. neomexicanus* do look accurately like each of those two species (Fery and Ribera 2018) based on drawings in Zimmerman and Smith (1975) and Zimmerman (1982). Another possibility is that they have a different species entirely, possibly an undescribed one. In any case, a locality record of *M. neomexicanus* from a site named "Álvaro Obregón" in Chihuahua remains dubious and in need of confirmation.

Finally, examination of museum specimens by Miller resulted in discovery of one specimen

Table 1. Bonito diving beetle (*Mystonectes neomexicanus*) known occurrence records. Localities are provided verbatim from the literature (Zimmerman and Smith, 1975; Zimmerman, 1982), corresponding database records, if available (Symbiota Collections of Arthropods Network (SCAN), 2025a; 2025b), or from label data from examined specimens. Latitude and longitude are based on approximations from indicated localities. Note that latitude and longitude of several database records of published specimens appear to be incorrect based on estimates from indicated locality information (Symbiota Collections of Arthropods Network (SCAN), 2025a; 2025b); these errors were corrected in the table below.

Locality	Coordinates (WGS84)	Date	Specimens	Citation
"Bonita [sic] Ck, 4 mi. W of Lincoln, Lincoln Co., New Mexico"	33.526 -105.438	6 Jun 1966	13	Zimmerman and Smith 1975
"Alamito Creek near Presidio, Texas"; "United States, Texas, Presidio, 7 miles E Presidio; Alamito creek 29.566881 -104.26021 +-11526m"	29.523 -104.290	1976; 29 Aug 1976	NA; NA	Zimmerman 1982; Symbiota Collections of Arthropods Network (SCAN); GBIF.org 2026
"Papagochic [sic] River, 10 mi W of La Junta, Chihuahua"; "Mexico, Chihuahua, 10 miles west Papagochic R. La Juanta 30.749891 -110.652241 +-14731m"	28.481 -107.483	NA	NA	Zimmerman 1982
"20 mi. S of Alpine Co., [sic] Texas"	30.072 -103.665	NA	1	Zimmerman and Smith 1975
"Lincoln Co., New Mexico Rio Hondo, 1 mi. W. Sunset"	33.331 -105.083	9 Mar 1967	1	Label from specimen in the Dr. Antonio 'Tony' Genaro Natural History Museum, Division of Invertebrates, Eastern New Mexico University

of *M. neomexicanus* in the Dr. Antonio 'Tony' Genaro Natural History Museum, Division of Invertebrates, Eastern New Mexico University (ENMU, D. Pollock, curator) (Table 1).

Mystonectes neomexicanus is, therefore, confirmed to have been collected at five sites based on published data (Zimmerman and Smith 1975; Zimmerman 1982); two in New Mexico, USA, two in Texas, USA, and one in Chihuahua, Mexico (Table 1, Fig. 2).

STATUS

Evidence

The species is considered lost, with the last known collection having been made in 1976 (Table 1). The species has attracted conservation attention because of its apparent rarity and lack of collections. Given the poor knowledge of the species and limited collecting of water beetles in the broad region in which it occurs, additional research is needed before assessing possible threats. As it is apparently found in small Chihuahuan Desert mountain streams (Zimmerman and Smith 1975; Zimmerman 1982), it may be impacted by a number of threats including grazing, habitat loss, drought, water use change, and wildfire (see below).

In 1991 *M. neomexicanus* was proposed for listing under the Endangered Species Act (U.S. Fish and Wildlife Service 1991). However, due to a lack of knowledge of its range and popula-

tion size it was determined that additional surveys were needed prior to any further consideration (U.S. Fish and Wildlife Service 1991). As a result, the species was listed as a Category 2 Federal Candidate Species (U.S. Fish and Wildlife Service 1994). Category 2 denoted species thought to be endangered but for which more information was needed to make a final decision (U.S. Fish and Wildlife Service 1980). Listing in this category provided the species with some federal protection (U.S. Fish and Wildlife Service 1991; 1994; U.S. Department of Agriculture 2024). In February 1996, the Fish and Wildlife Service decided to remove Category 2 designations, and, as a result, this species was no longer considered for federal protection (U.S. Fish and Wildlife Service 1996). Later that same year, all former Category 2 species were designated as Federal Species of Concern and the Bonito diving beetle retains this designation, although it is one which provides no legal protected status (New Mexico Natural Heritage 2025).

In 1998, the first known conservation assessment was done for the species by NatureServe, and it was determined to be Critically Imperiled (G1) (NatureServe 2024). The species was listed as a New Mexico Species of Greatest Conservation Need (SGCN) by the New Mexico Department of Game and Fish (2006), a designation that it retained for many years. It was later removed from the SGCN list along with all other insects presumably because of changes in priorities of the New Mexico executive branch. In 2007 it was listed as a "sensitive species" by the United States Forest Service, a designation it still retains (U.S. Department of Agriculture 2013). In 2018 the species was designated as a Bureau of Land Management sensitive species (BLM 2018). In 2023 a reassessment of this species was done by NatureServe, and it was found to be vulnerable to extinction globally (G3) and critically imperiled (S1) in both New Mexico and Texas due to the threat posed by drought (NatureServe 2024). In 2024 the Lincoln National Forest designated the Bonito diving beetle as a Species of Conservation Concern (U.S. Department of Agriculture 2024).

Search effort

Other than the historical collections described above, it is unknown how much search effort has occurred for this species. Recently, Miller made three attempts to locate the Bonito diving beetle. Collections at the type locality and upstream and downstream along the Rio Bonito in June and October 2024 and May 2025 did not result in collection of *M. neomexicanus*, although around 15 other species of water beetles typical of the region were collected.

Furthermore, while a graduate student at New Mexico State University (NMSU) in Las Cruces, New Mexico, Dr. David Lightfoot went on two separate field trips in 1983 and 1984, to search for the Bonito diving beetle at Bonito Lake, and at Alto Lake, both reservoirs northwest of Ruidoso, New Mexico, and near Ski Apache, New Mexico. One trip was with Dr. James Zimmerman, a dyticid expert from NMSU, and several of his graduate students who were working on dyticid taxonomy. The other trip was with a couple of the same graduate students as the previous trip. The group sampled at a time of year when Zimmerman expected to find the species, and the entire group was experienced at sampling and collecting aquatic insects. Both reservoirs on both trips were at high water levels, and both had healthy shoreline aquatic or semi aquatic vegetation for each trip. The group sampled shallow near-shore waters with dipnets, and also the streams flowing into both reservoirs. *Mystonectes neomexicanus* could not be found on either trip, but the group did find an abundance of other aquatic insects (D. Lightfoot pers. comm. 2026). It is unknown whether anyone else has made any effort to collect the species from New Mexico, Texas, or Mexico in the fifty years since its last sighting.

Threats

Very little research has been done on the life history and ecology of this species, so most conservation threats to the species are specula-

tive. A possible threat is drought, as it is a Chihuahuan Desert stream species and, therefore, potentially impacted by documented changes to precipitation in the region (Uribe 2022). The Southwestern US experienced its driest 22-year period from 2000 to 2021 since at least 800 CE (the time period used in previous climatic reconstructions) (Williams et al. 2022), and droughts are projected to become more prolonged, severe, and common in the region under future climate change scenarios (U.S. Global Change Research Program 2018). This could limit habitat available for the species and potentially cause extirpations of certain populations if streams experience historically atypical drying or reductions in flow. In conjunction with drought, human water use changes in the region may affect this species. Effects of low-flow disturbances (e.g. from drought or water use by humans) on lotic aquatic insect communities are not well documented but have been investigated and shown to be significant on some members of those communities (Walters 2011; Aspin et al. 2019; Machuca-Sepúlveda et al. 2024). Grazing and the introduction of invasive species such as wild hogs (*Sus scrofa*) can also demolish mineral substrates at aquatic-terrestrial margins significantly impacting aquatic species (Helcel et al. 2018).

Pesticide use could also adversely impact this species across its known range. For example, during the summers of 1983 and 1984, carbamate insecticides were sprayed using aerial application over 975 km² in the Sacramento Mountains at elevations from 1,830–3,350 m to control an outbreak of western spruce budworm (*Choristoneura freemani*) (Bennett and Linnane 1985). Even without these big spray programs there is a significant amount of rangeland in the area, and small sprays are frequent occurrences. It is not clear how susceptible water beetles are to such insecticide applications or potential runoff from agricultural or other pesticide use along the streams in which *M. neomexicanus* occurs, but macroinvertebrates in general have been demonstrated to be heavily impacted by such applications (Morrissey et al. 2015; Stehle and Schulz 2015; Liess et al. 2021). The finding of other dytiscid species by Miller, however, suggests that pesticide use may not be broadly affecting these beetles in the Rio Bonito.

Another potential threat to this diving beetle is wildfire. Fire suppression has been a key component of forest management in the range of this species since the early 1900s, resulting in dense conifer growth and increased fuel loads (Kaufmann et al. 1998). At least nine large fires have burned over 34,000 acres (≈ 138 km²) of land in the Sacramento Mountains in the last 50 years (Kaufmann et al. 1998; U.S. Fish and Wildlife Service 2004). These large fires can fill riparian ecosystems with ash and debris as well as open canopies to shifting autotrophy and sedimentation, heavily impacting aquatic insect life (Paul et al. 2022). More research is needed on potential threats to this species across its range, and more life history information is needed to accurately assess possible dangers.

It should be noted that water use, grazing management, and other potential environmental impacts in the Rio Bonito basin may have changed considerably in the past 50 years since *M. neomexicanus* was first encountered and described, and the habitat along the river may well have been modified commensurately. For example, in 1997 the Rio Bonito Corridor was designated by US congressional action and was intended to protect the riparian habitats along the Rio Bonito, which are vital for local wildlife and vegetation (Domenici and Bingaman 1997). In recent years, the BLM has continued its conservation initiatives in the area. For instance, in 2023, the BLM Roswell Field Office announced plans to collaborate with the New Mexico Department of Game and Fish and other partners to enhance riparian and fisheries habitat along approximately two miles of the Rio Bonito River on the Salazar Tract including proposed improvements such as installing in-stream fish habitat structures, planting native riparian vegetation, and recontouring sections of the floodplain to promote natural water flow (BLM 2023). Whether these conservation

efforts, and others, have changed the habitat profile of the region is not clear, but they could affect the distribution of *M. neomexicanus* in the area, and it is possible that the type locality was rather different at the time the species was first collected compared to now.

Rediscovery strategy

Additional surveys are needed for this species in and around the type locality in New Mexico as well as in Texas and Mexico where it has historically been recorded (Table 1). Several cursory attempts to collect the species at the type locality in New Mexico have failed to find specimens, so focusing collecting effort on places with similar habitats or on the known occurrences elsewhere in the Sacramento Mountains, in southeastern New Mexico, in western Texas, and northern Mexico will likely be important. There are numerous other streams in the Sacramento Mountains that are similar to Rio Bonito, but they have not been surveyed for the species. Given the lack of specific knowledge of the habitat or microhabitat of the species, efforts should focus on additional habitats where members of *Mystonectes* and the broader subtribe are typically collected such as more alkaline or saline pools and streams (Zimmerman and Smith 1975; Zimmerman 1982). It is possible the microhabitat of occurrence has not been collected during recent efforts, so sampling of additional microhabitats in the area should be emphasized. During survey efforts, it would also be valuable to document the broader assemblage of dytiscid beetles encountered at each site. Such data would provide important context for assessing regional impacts on diving beetles more broadly, including the effects of fire, pesticide exposure, exotic fish introductions, and climate-driven changes in hydrology, and may also help identify potential competitors of *M. neomexicanus*. Finally, arid lands within the range of *M. neomexicanus* exhibit considerable local variation in water availability, both annually and seasonally. This variability appears to influence composition and abundance of diving beetles at many sites where the species may occur (Miller unpublished), suggesting that timing of collection effort or repeated visits to potential sites may be important. The focal species still retains many conservation designations and so surveys should be completed in collaboration with designated conservation agencies.

CONCLUSION

Immediate efforts are needed to try to locate the Bonito diving beetle. Given how long it has gone unseen despite expert search efforts, and the number of conservation designations it holds, there is reason for concern about the well-being of this species. Diving beetles play a crucial role in maintaining aquatic ecosystems and are potentially important predators of pest organisms such as mosquito larvae (Vanslembrouck et al. 2024). Diving beetles are also a food source for vertebrates and other aquatic invertebrates. The Bonito diving beetle may also serve as an indicator of the impacts of changing water use and drought in the arid southwest.

ORCID

S.D. 0009-0007-7291-1849

Data accessibility

Occurrence data used in this study were obtained from the Global Biodiversity Information Facility (GBIF) doi:10.15468/dl.thznhy, as well as from peer-reviewed, publicly accessible journal articles. All occurrence records are reproduced in full in Table 1.

Author contributions

S.D. conceived the study (Conceptualization). S.D. and K.M. gathered data both in the field and from the literature (Investigation). S.D. wrote the first draft of the manuscript, and both authors contributed to reviewing and editing the manuscript (Visualization; Writing – original draft; Writing – review & editing).

Ethical standards

Field observations were conducted in accordance with applicable local regulations. Access to museum specimens was granted by the holding institutions. No permits or institutional approvals were required for this work.

Acknowledgements

Special thanks to G. Pollock and D. Pollock (Dr. Antonio 'Tony' Genaro Natural History Museum, Division of Invertebrates, Eastern New Mexico University) for allowing examination of their diving beetles. Thanks to Santiago Villamarín-Cortez for Spanish translation.

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