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# REASSESSMENT OF THE CONSERVATION STATUS OF THE CHILEAN DESERT LIZARD *LIOLAEMUS TORRESI* (NÚÑEZ, NAVARRO, GARÍN, PINCHEIRA-DONOSO & MERIGGIO, 2003, SQUAMATA, LIOLAEMIDAE): AN ENDANGERED (EN) OR NEAR THREATENED SPECIES (NT)?

## REEVALUACIÓN DEL ESTADO DE CONSERVACIÓN DE LA LAGARTIJA DEL DESIERTO CHILENO *LIOLAEMUS TORRESI* (NÚÑEZ, NAVARRO, GARÍN, PINCHEIRA-DONOSO & MERIGGIO, 2003, SQUAMATA, LIOLAEMIDAE): ¿UNA ESPECIE EN PELIGRO DE EXTINCIÓN (EN) O CASI AMENAZADA (NT)?

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**Resumen.—** *Liolaemus torresi* es una lagartija pequeña que habita en el desierto de Atacama de Chile, el cual es el desierto más árido del mundo. La especie fue registrada por primera vez en el año 1983, y no se vieron más especímenes hasta el año 2001. Varios autores han señalado que *L. torresi* tiene densidades poblacionales extremadamente bajas y, a la fecha se ha registrado solo en 18 localidades. El 2017, la Lista Roja de la UICN incluyó a *L. torresi* como una especie En Peligro (EN B1abiii,v) basándose en el criterio B1 de Extensión de Ocurrencia (EOO). Sin embargo, el polígono de EOO no incluyó la localidad tipo, las localidades de recolección de los paratipos, los registros más sureños, ni varios de los registros más norteños de su rango de distribución. Por otra parte, el Estado Chileno, a través de su Ministerio del Medio Ambiente, inicialmente (2018) propuso una categoría de conservación similar (EN B1abiii + 2abiii), pero después (2020) un decreto incluyó a *L. torresi* como Casi Amenazada (NT). En esta publicación, ampliamos el rango de distribución de *L. torresi* (cuatro registros nuevos) y se provee evidencia para algunos registros que carecían de ésta. Dado que las categorías de conservación de la UICN (EN) y la chilena (NT) no coinciden, reevaluamos el estado de conservación de *L. torresi* usando información actualizada y siguiendo las categorías y criterios de la UICN. Concluimos que *L. torresi* debería ser categorizada como NT y proveemos todos los antecedentes necesarios para una futura actualización de la Lista Roja.

**Palabras clave.—** Lista Roja, Unión Internacional para la Conservación de la Naturaleza (UICN), Extensión de Ocurrencia (EOO), distribución, localidad tipo, Atacama.

**Abstract.—** *Liolaemus torresi* is a small lizard that inhabits Chile's Atacama Desert, which is the driest desert in the world. The species was first recorded in 1983, and no more specimens were seen until 2001. Several authors have stated that *L. torresi* has extremely low population densities and, to date, it has been recorded in only 18 localities. In 2017, the IUCN listed *L. torresi* as an Endangered species (EN B1abiii,v), based on the B1 criterion of Extent of Occurrence (EOO). However, the EOO polygon did not include the type locality, the paratypes collection localities, the southernmost records, or several of the northernmost records of its distributional range. The Chilean State, through the Ministry of the Environment, initially (2018) proposed a similar conservation category (EN B1abiii + 2abiii), but later (2020) a decree listed *L. torresi* as Near Threatened (NT). In this paper, we expand the distributional range of *L. torresi*

(four new records) and provide evidence for some previous records that had been lacking it. Since the IUCN (EN) and the Chilean (NT) conservation categories do not match, we reassess the conservation status of *L. torresi* using updated information and following the IUCN categories and criteria. We conclude that *L. torresi* should be categorized as NT, and provide all the necessary background for a further Red List update.

**Keywords.–** Red List, International Union for Conservation of Nature (IUCN), Extent of Occurrence (EOO), distribution, type locality, Atacama.

## INTRODUCTION

The International Union for Conservation of Nature (IUCN) is the primary source for species conservation categories (Red List of Threatened Species), and the criteria and guidelines needed to establish them (IUCN, 2012a,b). Only ~40% of reptiles have been assessed by the IUCN (Meiri & Chapple, 2016), and this group has received markedly less attention than other groups of vertebrates like amphibians, birds and mammals (Chapple et al., 2021). Additionally, once a species assessment is carried out by the IUCN, an update might be needed if new data becomes available (e.g. Wilson et al., 2013). In southern South America, the lizard genus *Liolaemus* shows an extraordinarily high species diversity, with more than 270 species distributed mainly in Argentina and Chile, and with new species described each year (Abdala et al., 2021; Avila et al., 2021), of which 98 have been identified in Chile (Ruiz de Gamboa, 2020).

Chile's Ministry of the Environment (Ministerio del Medio Ambiente, MMA) uses its own assessment process to establish the species conservation categories. Currently, the conservation categories used in this assessment are the same as those listed by the IUCN (2012a): Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE). In summary, the Chilean assessment process consists of an initial proposal of conservation category (using the IUCN guidelines), followed by a public consultation and a final decision taken by the Council of Ministers (MMA, 2012). Thus, the resulting Chilean conservation category and the category used on the IUCN Red List do not always match. In regard to threatened species, the MMA lists four species of *Liolaemus* as CR, 19 as EN and 21 as VU (Ruiz de Gamboa, 2020). Worldwide, 40 species of *Liolaemus* are listed as threatened, according to the IUCN Red List (Table 1). Of these, the Red List includes two species of *Liolaemus* that occur in Chile as CR, ten as EN and five as VU (Ruiz de Gamboa, 2020).

*Liolaemus torresi* (Núñez, Navarro, Garín, Pincheira-Donoso & Meriggio, 2003) is a small lizard (maximum snout-vent length = 64 mm), with short snout, bulging eyes, a tail larger than its trunk and 60–68 scales around its mid-body (Núñez et al., 2003; Troncoso-Palacios & Escobar-Gimpel, 2020). It is endemic to Chile, inhabiting the northern part of the country, specifically the Atacama Desert – the most arid desert in the world – in the regions of Tarapacá and Antofagasta (Díaz-Vega, 2014; Núñez et al., 2003). Few ecological antecedents are known. It is an insectivorous and viviparous lizard, with a recorded birth of two offspring (Núñez et al., 2003) and low population densities (Riveros-Riffo & Torres-Mura, 2015). When this lizard perceives a threat, it runs to hide under or between rocks (Núñez et al., 2003), under which it digs its burrows (Riveros-Riffo & Torres-Mura, 2015). It has been observed on rocks, raising its limbs and tail to avoid the high temperatures of the desert (Díaz-Vega, 2015). DNA data of this species was first published by Ruiz de Gamboa et al. (2018). Later, Abdala et al. (2020) published the first broad phylogenetic study (total evidence) to include *L. torresi*, and found this species to be a member of the *L. reichei* clade. However, one DNA phylogenetic study, which did not include *L. torresi* (Aguilar-Puntriano et al., 2018), found that the *L. reichei* clade is not monophyletic. Thus, it can be inferred that there are some discrepancies on the higher taxonomy of *L. torresi*. We remark that the species was described for the genus *Phrynosaura*, considered long ago as a junior synonym of *Liolaemus* (Etheridge, 1995), a proposal widely supported by molecular evidence (Valladares et al., 2002; Schulte & Moreno-Roark, 2010; Aguilar-Puntriano et al., 2018; Ruiz de Gamboa et al., 2018; Abdala et al., 2020; Quiroz et al., 2021). Despite this, the species taxonomy is very stable, and to our knowledge, no publication has ever questioned its status as a valid taxon.

Chile's Ministry of the Environment initially proposed that *L. torresi* should be categorized as Endangered (EN, B1ab[iii] + 2ab[iii]), using both B1 and B2 criteria (MMA, 2018). The B1 criterion corresponds to the Extent of Occurrence (EOO). It is also accompanied by two conditions: a" severely fragmented distribution or number of locations ≤ 5; and "b" continuing decline observed, estimated, inferred or projected in any of iii (area, extent and/or quality of habitat). On the other hand, the B2 criterion corresponds to the Area of Occupancy (AOO). However,

**Tabla 1.** Todas las especies amenazadas (VU, EN, CR) y casi amenazadas de *Liolaemus* de la Lista Roja de la UICN (último acceso en enero, 2022). Se provee la Extensión de presencia (EOO, criterio B1) y el Área de ocupación (AOO, criterio B2). **L. manueli* se considera actualmente un sinónimo menor de *L. audituvelatus* (Ruiz de Gamboa et al., 2018). ***L. signifer* se considera actualmente un nomen dubium (Langstroth, 2021). En el caso de *L. torresi* se proveen ambas, la actual categoría de la UICN y nuestra propuesta.

**Table 1.** All threatened (VU, EN, CR) and Near Threatened *Liolaemus* species on the IUCN Red List (last accessed in January 2022). The Extent of Occurrence (EOO, B1 criterion) and the Area of Occupancy (AOO, B2 criterion) for each species are provided. **L. manueli* is currently considered a junior synonym of *L. audituvelatus* (Ruiz de Gamboa et al., 2018). ***L. signifer* is currently considered a nomen dubium (Langstroth, 2021). In the case of *L. torresi*, both the current IUCN category and our proposed category are provided.

| Species | EOO (km²) | AOO (km²) | IUCN Red List category |
|---|---|---|---|
| **Threatened species** | | | |
| *L. aparicioi* | 30 | – | Critically Endangered B1ab(i,iii) |
| *L. arambarensis* | 1,000 | – | Endangered B1ab(iii) |
| *L. audituvelatus* | 7,300 | – | Vulnerable B1ab(iii); D2 |
| *L. azarai* | – | 8 | Critically Endangered B2ab(iii) |
| *L. carlosgarini* | 96 | – | Vulnerable D2 |
| *L. cranwelli* | 0–20 | – | Critically Endangered () B1ab(i,iii) |
| *L. cuyumhue* | 5–99 | – | Critically Endangered B1ab(iii)+2ab(iii) |
| *L. dicktracyi* | – | 8 | Vulnerable D2 |
| *L. fabiani* | 2,600 | – | Endangered B1ab(iii) |
| *L. famatinae* | | 25 | Vulnerable D2 |
| *L. fittkaui* | 1,500 | – | Vulnerable B1ab(iii) |
| *L. forsteri* | 165 | – | Endangered B1ab(i) |
| *L. frassinettii* | – | 4 | Vulnerable D2 |
| *L. gravenhorstii* | 4,478 | – | Endangered B1ab(iii) |
| *L. halonastes* | – | 8 | Vulnerable D2 |
| *L. hellmichi* | – | 4 | Vulnerable D1 |
| *L. insolitus* | 360 | – | Endangered B1ab(iii,iv) |
| *L. leopardinus* | 240 | – | Endangered B1ab(i,iii) |
| *L. loboi* | – | 16 | Endangered B1ab(iii)+2ab(iii) |
| *L. lorenzmuelleri* | 1,700 | – | Endangered B1ab(iii) |
| *L. lutzae* | – | – | Vulnerable A1c+2c |
| *L. manueli** | 1,700 | – | Endangered B1ab(iii) |
| *L. martorii* | 9,000 | – | Vulnerable B2ab(ii,iii) |
| *L. morenoi* | – | 20 | Vulnerable D2 |
| *L. multimaculatus* | – | 424 | Endangered B2ab(ii,iii) |
| *L. occipitalis* | – | – | Vulnerable B1+2bc |
| *L. paulinae* | 90 | – | Critically Endangered B1ab(i,iii) |
| *L. poconchilensis* | 1,300 | – | Endangered B1ab(iii) |
| *L. rabinoi* | 4 | 4 | Critically Endangered b(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) |
| *L. riodamas* | 250 | 1–250 | Endangered B1ab(i,iii,v)+2ab(i,iii,v) |
| *L. robertoi* | 2,870 | – | Endangered B1ab(iii) |
| *L. salinicola* | 1,800 | – | Endangered B1ab(iii,v) |
| *L. scapularis* | 2,000 | – | Endangered B1ab(i,iii,v) |
| *L. stolzmanni* | 600 | – | Endangered B1ab(iii,v) |
| *L. tandiliensis* | 6,093 | – | Vulnerable B1ab(iii,iv,v) |
| *L. thermarum* | 78 | – | Vulnerable D2 |
| *L. torresi (current)* | 4,900 | – | Endangered B1ab(iii,v) |
| *L. tregenzai* | – | 10 | Vulnerable D2 |
| *L. variegatus* | 15,960 | – | Vulnerable B1ab(iii) |
| *L. villaricensis* | – | – | Vulnerable D2 |
| **Near Threatened species** | | | |
| *L. chavin* | 4,830 | – | Near Threatened |
| *L. quilmes* | 5,000 | – | Near Threatened |
| *L. robustus* | 12,265 | – | Near Threatened |
| *L. rosenmanni* | 4,900 | – | Near Threatened |
| *L. signifer*** | 92,000 | – | Near Threatened |
| *L. silvai* | 70 | – | Near Threatened |
| *L. tacnae* | 5,400 | – | Near Threatened |
| *L. torresi (our pro-posal)* | 21,712–22,073 | – | Near Threatened |
| *L. valdesianus* | 160 | – | Near Threatened |
| *L. vallecurensis* | 9,000 | – | Near Threatened |
| *L. walkeri* | 8,000 | – | Near Threatened |

the final decision taken by the Council of Ministers was to classify it as Near Threatened (MISP, 2020). We remark that MISP (2020) is a legal regulation (decree) and does not provide arguments or technical analysis on the *L. torresi* conservation category. For its part, the IUCN Red List includes *L. torresi* as Endangered (EN, B1ab[iii,v]; Espejo et al., 2017), in which "v" corresponds to the number of mature individuals.

Since the IUCN conservation category (EN) and the Chilean legal conservation category (NT) do not match, in this paper we perform a reassessment of the conservation category of *L. torresi*, based on IUCN criteria (IUCN, 2012a), with the aim of providing an updated classification proposal.

## MATERIALS AND METHODS

We followed the criteria, categories (v. 3.1, IUCN, 2012a) and guidelines (v4.0, IUCN, 2012b) of the IUCN to provide an assessment of the conservation status of *L. torresi*. The IUCN uses three categories for the threatened species (CR, EN and VU), and two categories for species not threatened but with enough data to provide an assessment (Near Threatened [NT] and Least Concern [LC]). Five criteria can be used to establish the conservation category (using one or in combination): A: population size reduction, B: geographic range, C: small population size and decline, D: very small or restricted population, and E: quantitative analysis. Since no population size or qualitative population analysis has been published for *L. torresi*, we used the B criterion for the assessment of its conservation status, which is the same criterion used by the IUCN assessment (Espejo et al., 2017) and by the Chilean Ministry of the Environment assessment (MMA, 2018). The voucher codes mentioned use the following acronyms: MNHNCL (National Museum of Natural History of Chile), MUAP (Museum of the University Arturo Pratt of Iquique) and SSUC Re (Collection of the Pontifical Catholic University of Chile). We reviewed almost all the type specimens, and one additional specimen of *L. torresi*, to confirm the diagnostic traits proposed in the literature (Núñez et al., 2003; Valladares-Faúndez et al., 2018; Troncoso-Palacios & Escobar-Gimpel, 2020), which are listed in Appendix I.

The paratypes that were not examined are one of unknown sex (MNHNCL 1458), two neonates (MNHNCL 3534–35), one diaphonized (MNHNCL 3381) and an adult male (MNHNCL 3542). We reviewed all literature concerning *L. torresi*, including papers published via peer review in scientific journals (Díaz-Vega, 2014, 2015; Donoso-Barros, 1969; Núñez & Gálvez, 2015; Núñez et al., 1998, 2003; Riveros-Riffo & Torres-Mura, 2015; Ruiz de Gamboa et al., 2018; Troncoso-Palacios and Escobar-Gimpel, 2020) and two books (Demangel, 2016; Mella, 2017). In the case of Demangel (2016), we used only the records provided with photographic evidence that allow unambiguous species identification, since the taxonomic treatment of this book has been received with rejection or caution (Abdala et al., 2021; Ruiz de Gamboa, 2020; Troncoso-Palacios et al., 2019). Additionally, Ignacio Fernández Latapiat provided one record of *L. torresi* from ENGIE wind farm (22°27'S – 68°48'W), supported through photographic evidence (Figs. 1 and 2).

Finally, E. Riveros-Riffo kindly sent us data (geographic coordinates and photographs) of five records of L. torresi (Figs. 1 and 2), three of which are new: Challacollo (the northernmost record of this species, 20°53'S – 69°22'W), Toco (22°03'S – 69°34'W) and North Sierra Gorda (22°45'S – 69°17'W), while two were previously listed by Riveros-Riffo and Torres-Mura (2015) but evidence was not published. All coordinates provided in UTM or decimal degrees in the original publication were transformed into geographic coordinates (degrees and minutes). We estimated the Extent of Occurrence (EOO), which is the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known sites of present occurrence of a taxon (IUCN, 2012a). Geographic data was managed using Google Earth Pro v7.3.

## RESULTS AND DISCUSSION

### Literature analysis

Nine peer-reviewed publications (Díaz-Vega, 2014, 2015; Donoso-Barros, 1969; Núñez & Gálvez, 2015; Núñez et al., 1998, 2003; Riveros-Riffo & Torres-Mura, 2015; Ruiz de Gamboa et al., 2018, Troncoso-Palacios & Escobar-Gimpel, 2020) and two books (Demangel, 2016; Mella, 2017) mention geographic records for *L. torresi*. However, only some of these include original records, which are summarized in Table 2. The altitudinal range of *L. torresi* is 790 – ~2,600 m a.s.l.

Some problems were noted. The record from 17 km east of Sierra Gorda (Mella, 2017) is stated as based on personal comments by Gabriel Lobos, but photographs are credited to Pablo Espejo. According to Riveros-Riffo and Torres-Mura (2015), the southernmost records of *L. torresi* are Quebrada Ordoñez, Rencoret and Mantos Blancos, although they provide no evidence (no voucher specimen codes or photographs). However, E. Riveros-Riffo sent us photographs of *L. torresi* from Quebrada Ordoñez and Rencoret (Fig. 1). Unfortunately, no evidence to support the southernmost record from Mantos Blancos is available, thus, we considered this record as doubtful. Moreover, recently, Troncoso-Palacios and Escobar-Gimpel

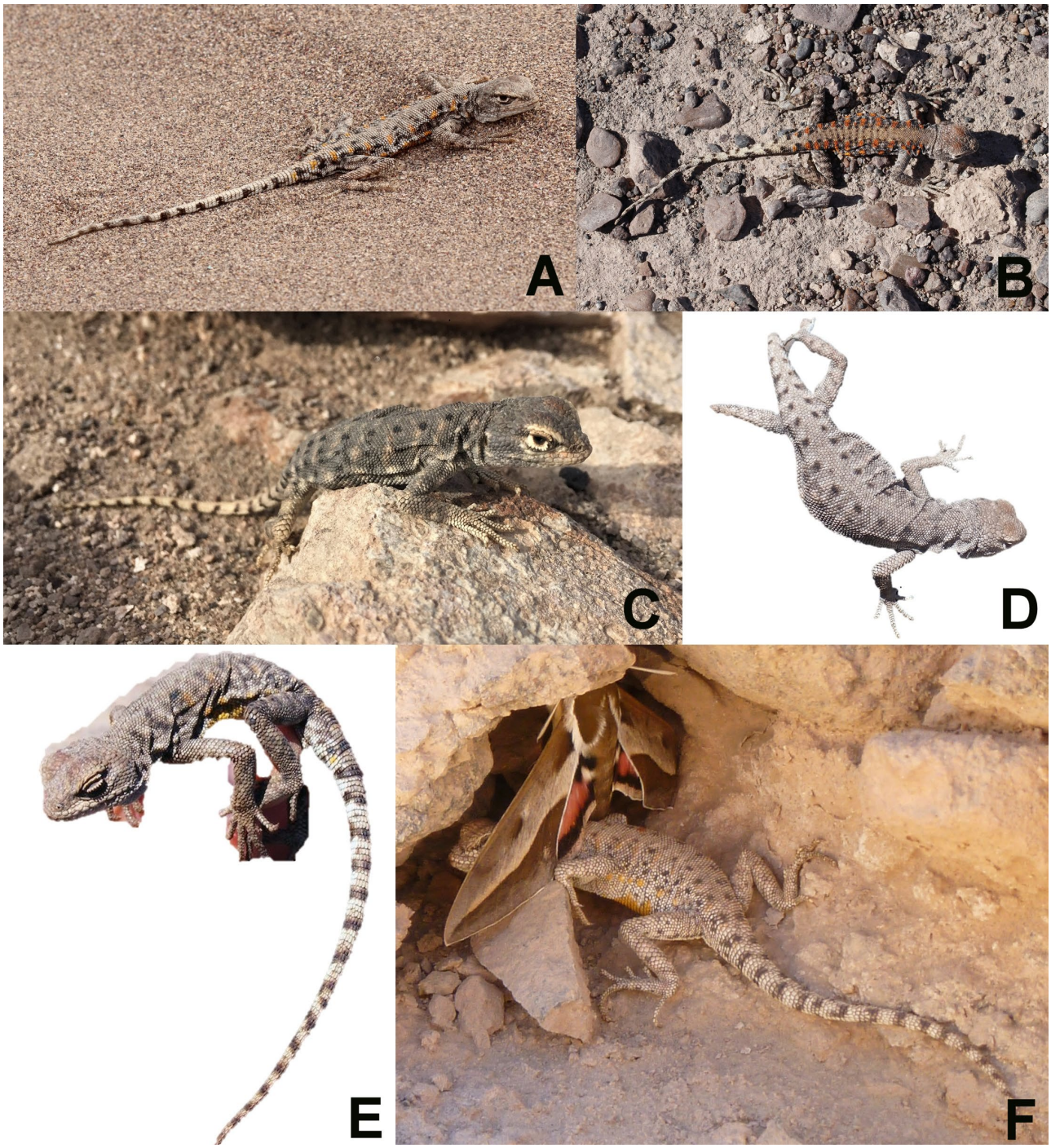


**Figura 1.** Evidencia fotográfica para los nuevos registros y algunos previos de *L. torresi*, ordenados de norte a sur. A) Challacollo, Región de Tarapacá, nuevo registro (fotografía por E. Riveros-Riffo). B) Toco, Región de Antofagasta, nuevo registro (fotografía por E. Riveros-Riffo). C) Campo eólico ENGIE, Región de Antofagasta, nuevo registro (fotografía por I. Fernández Latapiat). D) Norte de Sierra Gorda, Región de Antofagasta, nuevo registro (fotografía por E. Riveros-Riffo). E) Quebrada Ordoñez, Región de Antofagasta (fotografía por E. Riveros-Riffo). F) Rencoret, Región de Antofagasta (fotografía por E. Riveros-Riffo), nótese que en esta última está acompañado por un individuo de la especie de polilla *Hyles annei*.

**Figure 1.** Photographic evidence for new distributional records and some previous records of *L. torresi*, ordered from north to south. A) Challacollo, Tarapacá Region, new record (photograph by E. Riveros-Riffo). B) Toco, Antofagasta Region, new record (photograph by E. Riveros-Riffo). C) ENGIE wind farm, Antofagasta Region, new record (photograph by I. Fernández Latapiat). D) North of Sierra Gorda, Antofagasta Region, new record (photograph by E. Riveros-Riffo). E) Quebrada Ordoñez, Antofagasta Region (photograph by E. Riveros-Riffo). F) Rencoret, Antofagasta Region (photograph by E. Riveros-Riffo), note that this last one is accompanied by an individual of the moth species *Hyles annei*.

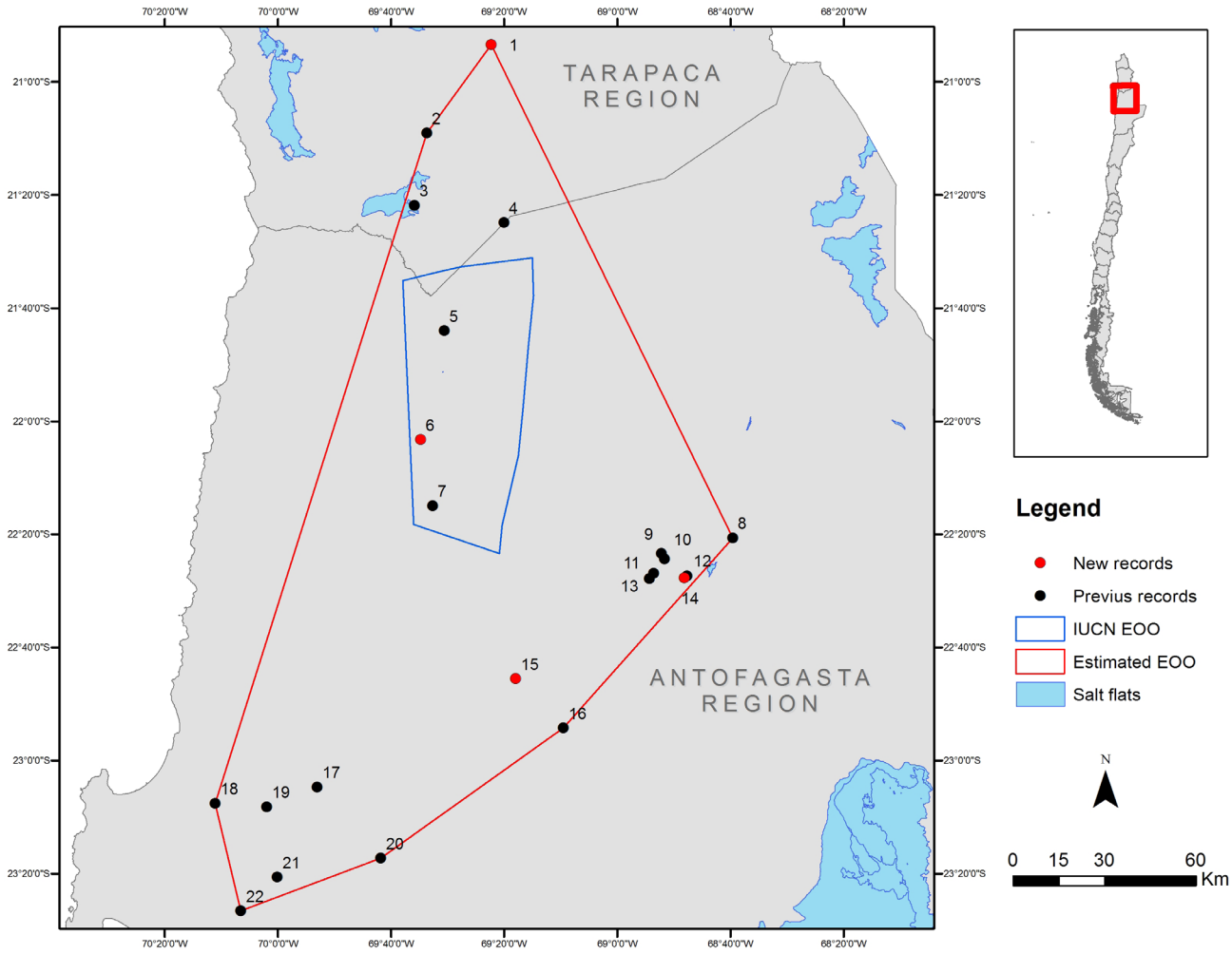


**Figura 2.** EOO of *L. torresi* and its records: Blue polygon = IUCN EOO, Red polygon = EOO estimated in this study. The records are shown with consecutive numbers ordered from north to south (black for previous records and red for new records). The names of the localities are provided in Table 2. Type locality = 9. Paratype collection localities = 10–13.

**Figure 2.** EOO de *L. torresi* y sus registros. Polígono azul = UICN EOO. Polígono rojo = EOO estimado en este estudio. Los registros se muestran con números consecutivos ordenados de norte a sur (negro para registros anteriores y rojo para los nuevos). Los nombres de las localidades se proveen en la Tabla 2. Localidad tipo = 9. Localidades de recolección de los paratipos = 10–13

(2020) restricted the type locality of *L. stolzmanni* (Steindachner, 1891) to transect between Antofagasta and Mejillones, near Mantos Blancos. Since both species are similar, the record of *L. torresi* from Mantos Blancos needs confirmation.

Núñez and Gálvez (2015) modified several of the previously published records of *L. torresi*, without providing an explanation for this. They list coordinates and localities for this species as *Liolaemus torresi* (p. 70), but also as *Phrynosaura torresi* (p. 164). Riveros-Riffo and Torres-Mura (2015) list a record from Estación La Rioja, 23°04'S – 69°53'W (provided in UTM and transformed into geographic coordinates by us), based on the specimen MNHNCL 4853, but Núñez and Gálvez (2015) provide a different locality name with the same coordinates for this specimen: "Sierra Gorda, Baquedano". Since Edvin Riveros is the collector (Núñez & Gálvez, 2015), we use Riveros-Riffo and Torres-Mura (2015) for the locality name. In the species description, Núñez et al. (2003) stated that the holotype MNHNCL 3382 was collected in the Salar del Indio SW Chuiquicamata 22°23'S – 68°52'W (type locality), but Núñez and Gálvez (2015) listed the type locality as "Salar de Indias" with different coordinates "22°23'S – 68°51'W". The voucher label has the following data: Salar de Indias, 22°23'S

**Tabla 2.** Registros de *Liolaemus torresi*, ordenados de norte a sur. Algunas altitudes fueron estimadas con Google Earth Pro v7.3.

**Table 2.** Records of *Liolaemus torresi*, ordered from north to south. Some altitudes were estimated with Google Earth Pro v7.3.

| Locality | Región | Coordinates (degrees and minutes) | Altitude (m asl) | Reference | Evidence and date (year) |
|---|---|---|---|---|---|
| Challacollo | Tarapacá | 20°53′ S – 69°22′ W | ~1,200 (estimated) | New record | Photographs, 2014 |
| Quebrada Guatacondo | Tarapacá | 21°09′ S – 69°33′ W | 790 | Díaz-Vega (2014) | Photographs, date unknown |
| Salar Llamara | Tarapacá | Not provided (21°21′ S – 69°35′ W estimated) | Not provided (~800 estimated) | Demangel (2016) | Photographs, date unknown |
| Quebrada Sama | Tarapacá | 21°24′ S – 69°20′ W | 1,038 | Díaz-Vega (2014) | Photographs, date unknown |
| Southern Quillagua | Antofagasta | Not provided (21°39′ S – 69°31′ W estimated) | Not provided (~900 estimated) | Demangel (2016) | Photographs, date unknown |
| Toco | Antofagasta | 22°03′ S – 69°34′ W | ~1,100 (estimated) | New record | Photographs, 2020 |
| María Elena | Antofagasta | 22°14′ S – 69°32′ W | 2,500 | Díaz-Vega (2014) | SSUC Re 608, 2013 (P. Zavala, pers. comments) |
| Chiuchiu | Antofagasta | Not provided (22°20′ S – 68°39′ W estimated) | Not provided (~2,600 estimated) | Demangel (2016) | Photographs, unknown date |
| Salar del Indio/ Salar de Indias, SW Chuquicamata (type locality) | Antofagasta | 22°23′ S – 68°52′ W | 2430 | Núñez et al. (2003) / Ruiz de Gamboa et al. (2018) | MNHNCL 3382–83, MNHNCL 3386–87 / MUAP 111–12, 2001 and date unknown, respectively |
| Talabre reservoir, road | Antofagasta | 22°24′ S – 68°51′ W | Not provided (~2,400 estimated) | Núñez et al. (2003) | MNHNCL 3384, 2001 |
| Calama, Loa river | Antofagasta | 22°26′ S – 68°53′ W | Not provided (~2,300 estimated) | Núñez et al. (2003) | MNHNCL 3542, 2002 |
| Talabre reservoir, Calama | Antofagasta | 22°27′ S – 68°47′ W | 2,485 | Núñez et al. (2003) | MNHNCL 3381, 2001 |
| Calama, Loa riverside / Topater bridge | Antofagasta | 22°27′ S – 68°54′ W | Not provided (~2,300 estimated) | Núñez et al. (2003) / Núñez and Gálvez (2015) | MNHNCL 1458, 1983 |
| ENGIE wind farm | Antofagasta | 22°28′ S – 68°47′ W | 2,474 | New record | Photographs, 2020 |
| North Sierra Gorda | Antofagasta | 22°45′ S – 69°17′ W | ~1,700 (estimated) | New record | Photographs, 2018 |
| 17 km East from Sierra Gorda | Antofagasta | 22°54′ S – 69°09′ W | 2,000 | Mella (2017) | Photographs, date unknown |
| La Rioja Station | Antofagasta | 23°04′ S – 69°53′ W (provided in UTM and transformed) | 1,332 | Riveros-Riffo and Torres-Mura (2015) | MNHNCL 4853, 2012 |
| Quebrada Ordoñez | Antofagasta | 23°07′ S – 70°11′ W (provided in UTM and transformed) | 838 | Riveros-Riffo and Torres-Mura (2015) | Photographs published in this study, 2009 |

**Tabla 2 (cont).** Registros de *Liolaemus torresi*, ordenados de norte a sur. Algunas altitudes fueron estimadas con Google Earth Pro v7.3.
**Table 2 (cont.).** Records of *Liolaemus torresi*, ordered from north to south. Some altitudes were estimated with Google Earth Pro v7.3.

| Locality | Región | Coordinates (degrees and minutes) | Altitude (m asl) | Reference | Evidence and date (year) |
|---|---|---|---|---|---|
| Sierra Valen-zuela | Antofagasta | 23°08´ S – 70°01´ W (provided in UTM and transformed) | 1,227 | Riveros-Riffo and Torres-Mura (2015) | Photographs, 2009 |
| Cerrillos | Antofagasta | 23°17´ S – 69°41´ W (provided in UTM and transformed) | 1,509 | Riveros-Riffo and Torres-Mura (2015) | Photographs, 2009 |
| Rencoret | Antofagasta | 23°20´ S – 70°00´ W (provided in UTM and transformed) | 1,271 | Riveros-Riffo and Torres-Mura (2015) | Photographs published in this study, 2012 |
| Mantos Blan-cos | Antofagasta | 23°26´ S – 70°06´ W (provided in UTM and transformed) | 790 | Riveros-Riffo and Torres-Mura (2015) | No evidence available/ doubtful record |

– 68°52'W. Despite these differences, the coordinates 22°23'S – 68°52'W correspond to the locality known as "Salar del Indio", which is the correct type locality, as provided by Núñez et al. (2003). The same problem occurs with the allotype MNHNCL 3383.

Núñez et al. (2003) listed a record from Calama, Loa riverbank, based on the specimen MNHNCL 1458 (collected in 1983), but without coordinates. However, Núñez and Gálvez (2015) clarified that this record is from Topater bridge 22°27'S – 68°54'W. The paratype MNHNCL 3542 is listed as collected in Calama, Loa River 22°26'S – 68°53'W by Núñez et al. (2003), but listed as collected in Topater bridge 22°27'S – 68°54'W by Núñez and Gálvez (2015). The paratype MNHNCL 3381 is listed as collected in Calama, Talabre reservoir 22°27'S – 68°47'W by Núñez et al. (2003), but with coordinates 22°23'S – 68°51'W by Núñez and Gálvez (2015). The paratypes MNHNCL 3384–85 are listed as collected in the Talabre reservoir, road 22°24'S – 68°51'W by Núñez et al. (2003), but with coordinates 22°23'S – 68°51'W by Núñez and Gálvez (2015). The coordinates of these specimens label match with Núñez et al. (2003). Paratype MNHNCL 3386 is listed as collected in Salar del Indio (type locality) 22°23'S – 68°52'W by Núñez et al. (2003), but listed as collected in the Talabre reservoir 22°23'S – 68°51'W by Núñez and Gálvez (2015). The locality name and coordinates of the voucher label match with Núñez et al. (2003). Paratype MNHNCL 3387 is listed as collected in Salar del Indio (type locality) 22°23'S – 68°52'W by Núñez et al. (2003), but as collected in the Talabre reservoir 22°23'S – 68°51'W by Núñez and Gálvez (2015). The locality name and coordinates of the voucher label match with Núñez et al. (2003). The same occurs with the paratypes MNHNCL 3534–35.

Donoso-Barros (1969) listed the specimen "000.001" (DB, personal collection) of *L. reichei* (Werner, 1907) from near Calama (without coordinates). This distribution matches with *L. torresi*, and not with the morphologically similar *L. reichei* (Troncoso-Palacios & Escobar-Gimpel, 2020; Valladares-Faúndez et al., 2018). According Donoso-Barros (1969), this specimen is placed in the Smithsonian Collection of reptiles, and Núñez et al. (1998) clarified that the voucher code is USNM 165638. Unfortunately, we were unable to check the voucher identity, because visits and image requests to the Smithsonian Collection are not permitted under the current COVID-19 restrictions. Ruiz de Gamboa et al. (2018) listed a record "near Maria Elena", based on specimen MUAP–116, but the coordinates were not provided. However, Díaz-Vega (2014) provided coordinates for a record from Maria Elena. Mella (2017) provided photographic evidence for a record from inland Calama, based on photographs by R. Díaz-Vega, but since the coordinates were not available, he provided the coordinates of Calama city (J. Mella personal comments), thus we did not include this record in our analysis.

## Current conservation categories analysis

In regard to the threats that affect *L. torresi*, Espejo et al. (2017) listed as threats the widespread mining activity in the area, the ongoing growth of mining activities and urban expansion (Calama city) in its distributional range, while the MMA (2018) also listed activities related to electricity generation and transmission. Both, Espejo et al. (2017) and the MMA (2018) concluded that these activities may lead to habitat loss and contamination, thereby affecting the species resources (prey). Espejo et al. (2017) also point out the low population density ~1 individual/km2 (also noted by Núñez et al., 2003; Riveros-Riffo & Torres-Mura, 2015), and ongoing population decline; but they clarify that there is not enough data to estimate a rate of population decline. In fact, Espejo et al. (2017) list the following attempts to carry out a species census (year and census result): in 2000, approximately 15-17 individuals were found in a 1 km

transect; in 2012, two individuals were found in a 3 km transect; in 2013, two live and one dead individuals were found in a 60 km transect; in 2015, two live and three dead individuals were found in a 1 km transect; in another survey in 2015, two live and one dead individual were found in a 2-hour search; and, in 2016, two individuals were found, one of which was emaciated.

Espejo et al. (2017) point out that they found emaciated and dead individuals, which they proposed that implied that resources in some locations had been diminished. Mummified individuals were recorded by Núñez et al. (2003) and Díaz-Vega (2014), but in this case, this was attributed to the harsh environmental habitat of this species. Espejo et al. (2017) stated that *L. torresi* did not occur in protected areas, and although our estimated EOO is much larger than the EOO used by Espejo et al. (2017), we also found that *L. torresi* did not occur in protected areas (see below). Espejo et al. (2017) stated that the species is no longer found in some locations (local extinction), but they did not mention which locations.

As previously mentioned, *L. torresi* is categorized as Endangered (EN) B1ab (iii,v) by the IUCN (Espejo et al., 2017), with an estimated EOO of 4,900 km2. However, we remark that the EOO polygon estimated by Espejo et al. (2017) was inaccurate (Fig. 2) since, considering the data available on that date, they did not include the type locality of *L. torresi*, the localities where the paratypes were collected (Núñez et al., 2003), several of the northernmost records (Díaz-Vega, 2014; Demangel, 2016), or all the southernmost records (Riveros-Riffo & Torres-Mura, 2015). Besides, it is unclear how they estimated their EOO, since the vertices of their EOO polygon do not match any of the know records of *L. torresi*.

The Chilean assessment (MMA, 2018) proposed the category Endangered (EN) B1ab(iii) + 2ab(iii), with an estimated EOO of 18,390 km² and an AOO of 400 km². It is also stated that the species occurred in 16 locations. However, the assessment used both B1 (EOO) and B2 (AOO) criterion for *L. torresi*, a species with a relatively large distributional range. This differs in regard to all 40 *Liolaemus* currently listed on the Red List as threatened (Table 1), which are categorized only with B1 criterion (species with large geographical range) or B2 criterion (species with very small distributional range that are endemic to five locations or fewer), but not using both criteria, with only two exceptions of *L. riodamas* and *L rabinoi*. However, these cases are very different compared to *L. torresi*, since both species have a very restricted distributional ranges (Esquerré et al., 2016; Abdala et al., 2017). The use of the B1 criterion, without adding the B2 criterion, for a *Liolaemus* with a large distributional range, like *L. torresi*, is justified because it avoids the effect of the undersampling of a species with low population density and small size that inhabits one of the most inhospitable places on earth. It is also unclear how MMA (2018) estimated an AOO of 400 km² with a grid of 2 x 2 km (following IUCN, 2012a), because it is not possible to reach 400 km² (sum of the area of all grids with records) with only 16 records, since at least 100 different records are needed.

### Conservation category proposal

We estimated an EOO of 22,073 km², considering all records provided with coordinates (Table 2). If the doubtful record is excluded (Mantos Blancos, Table 2), the estimated EOO is 21,712 km². Based on both EOO estimations, *L. torresi* does not fit the B1 criterion of the IUCN (2012a) for a threatened species, because its EOO is not < 20,000 km² (EOO should be < 20,000 km² for VU, < 5,000 km² for EN, and < 100 km² for CR). Therefore, we propose that, based on all published and new distributional data, the conservation category of *L. torresi* should be Near Threatened (NT), since this species occurs in more than 10 locations and has a large EOO (Fig. 2, Table 2).

We did not estimate an AOO, because it is unclear if this species really inhabits only 22 locations (Table 2), especially taking into account the low species density and that few expeditions to search for *L. torresi* have been carried out (almost all records were registered in the last 20 years, Table 2). However, clearly *L. torresi* could be threatened in the future by mining activity, urban expansion, and electricity generation and transmission projects (Espejo et al., 2017; MMA, 2018). If these projects are not developed in an appropriate way that ensures the protection of *L. torresi* habitats, this may lead to fragmented distribution (Espejo et al., 2017; MMA, 2018) and the decline of both its EOO and the quality of its habitat.

A further population study will be required to determine if there are a low number of mature individuals due to a population decline (Espejo et al., 2017; MMA, 2018), or if the few number of adults detected by location is due to the species biology itself. Finally, despite its large distributional range, one more argument in favour of considered this species as near threatened is that it is not found in protected areas (Espejo et al., 2017; this study), which may complicate its conservation in the future, especially if its EOO decreases.

## CONCLUSIONS

Our proposal matches the current Chilean legal conservation category NT (MISP, 2020), but does not match the current IUCN Red List category EN (Espejo et al., 2017) or the initial proposal

of the Ministry of the Environment EN (MMA, 2018). This is partly due to the problems noted in the previous categorization assessments, but also because we have greatly expanded the EOO through new distributional records. Thus, a further update of the IUCN Red List conservation category for *L. torresi* is required.

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## APPENDIX I

### Specimens examined

*Liolaemus torresi*. MNHNCL 3382–83 (holotype and allotype, respectively), 3386–87 (paratypes). Salar del Indio, SW from Chuquicamata, Antofagasta Region, Chile. MNHNCL 3384–85 (paratypes). 1.3 km, W from Talabre reservoir, Carretera, Antofagasta Region, Chile. SSUC Re 608 (mummified specimen). María Elena, Antofagasta Region, Chile.