

New distributional records and natural history notes for *Liolaemus lobo* (Abdala, 2003) in Río Negro and Neuquén Provinces, Argentina

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ABSTRACT

Liolaemus lobo Abdala, 2003 is a rare liolaemid lizard originally described from the border between Neuquén and Río Negro Provinces in Patagonia Argentina. Only a few specimens of this species exist in museums, and all are from the type locality near Bariloche. Here, we present two new records that result in a significant extension of the known distribution of the species. In addition, we comment on the habitat of *Liolaemus lobo*, its phylogenetic relationships, and selected aspects of its natural history.

Key Words: Liolaemidae, conservation status, habitats, reproduction, behavior.

The genus *Liolaemus* Wiegmann, 1834 contains 279 species (Abdala *et al.*, “*in press*”), and is the third-most speciose genus of reptiles, after *Anolis* Daudin, 1802 (436 species) and *Cyrtodactylus* Gray, 1827 (299 species) (Peter Uetz *pers. comm.* to RDS 20200606). While the description of species of *Liolaemus* is an active pursuit, there is much less known about the distribution and natural history of these new species. *Liolaemus lobo* Abdala, 2003 is an example of such a case, where the original description is the only source of information on the natural history of the species. *Liolaemus lobo* is characterized by being a medium-sized liolaemid, max. snout-to-vent length (SVL), 72.6 mm, and having marked sexual dichromatism. Males have a dorsal coloration pattern with 9 to 11 subquadrangular or striated paravertebral spots,

with evident pre- and postscapular spots and of similar size; gular region without melanism present, ventral tail color more intense than cloaca and belly. Females have a lighter brown dorsal coloration, with a pair of darker-brown chevrons on the dorsum that fuse into bands on the tail, and narrow cream-white paravertebral stripes. Because of this sexual dichromatism, adults of the two sexes are easily distinguished in the field. Scales around the body are 59-70, dorsal scales 63-73, ventral scales 94-113. Precloacal pores 8 – 11 in males, 0 to 2 in females (Abdala, 2003). Abdala (2003) reported that *L. lobo* inhabits the Patagonian steppe near Nahuel Huapi Lake, in an environment associated with sandy soil, rocks, and steppe vegetation. The type locality of *L. lobo* is “Intersection of national routes 237 and

231, Los Lagos Department, Neuquén Province, Argentina” (Abdala, 2003) (Fig. 1). Subsequently, Abdala and Lobo (2006) reported it for San Ignacio, Neuquén (-39.8484; -70.6648). However, Abdala *et al.* (2012a) described *Liolaemus purul*, including the San Ignacio population within its synonymy. Pérez *et al.* (2011) cited it for Río Negro Province near the type locality (Fig. 1).

The phylogenetic relationships of *L. lobo* Abdala, 2003 have been changing according to the proposed hypotheses. The genus *Liolaemus* is assigned to various groups and subgroups. *Liolaemus lobo* belongs to the monophyletic *Liolaemus boulengeri* (“patch group”) lineage of Etheridge (1995). The group is defined by the presence of enlarged scales on the posterior sides of the femurs (Abdala, 2003; Abdala *et al.*, 2012a). According to Abdala (2007), *Liolaemus lobo* belongs to the clade of *Liolaemus telsen* which is included within the *L. boulengeri*

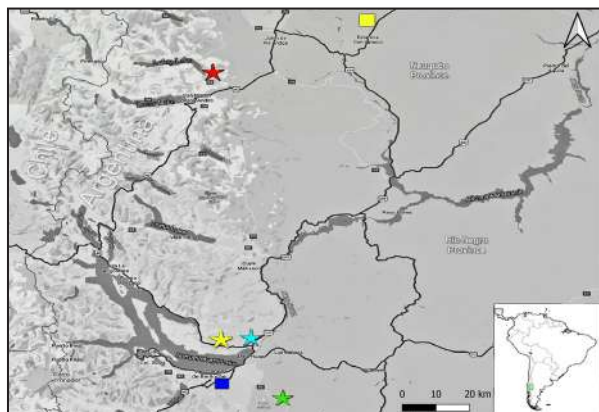


Figure 1. Known localities for *Liolaemus lobo*. **Cyan star:** Type locality (Abdala, 2003) Los Lagos Department, Neuquén Province. **Yellow star:** New record for *Liolaemus lobo* 10 km for West of type locality Los Lagos Department, Neuquén Province. **Red star:** New record for *Liolaemus lobo*, at Lolog Lake, Lacar Department, Neuquén Province. **Green star:** New record for *Liolaemus lobo*, near Cerro Bernal in Pilcaniyeu Department, Río Negro Province. **Blue square:** Locality cited by Pérez *et al.* (2011) in Bariloche, Río Negro province. **Yellow square:** Localities cited by Abdala and Lobo (2006), type locality *Liolaemus purul* Abdala *et al.* (2012a), at San Ignacio, Collón Curá Department, Neuquén Province.

group. This hypothesis is consistent with that of Ávila *et al.* (2006) in which they call the *L. telsen* clade the “*boulengeri* complex”. It has also been indicated as a sister species of *L. tehuelche* (Ávila *et al.*, 2006; Abdala 2007; Nori *et al.*, 2010; Paz 2012; Abdala *et al.*, 2016), as a sister species of *L. tromen* (Ávila *et al.*, 2013; Olave *et al.*, 2014), as basal to the entire clade of *L. telsen* (Abdala *et al.*, 2012a), and as a sister species to (*L. hermannunezi* + *L. sp.* M34) (Olave *et al.*, 2017). In summary, the phylogenetic relationships

of the species have yet to be accurately defined in a comprehensive study that includes more populations and morphological and molecular characters.

About *Liolaemus lobo*, few museum specimens are known: The type series consists of 14 specimens deposited in the Herpetological collection of the Miguel Lillo Foundation in Tucumán Province, three specimens deposited in the Museo de Ciencias Naturales of UNSa collection in Salta Province, and three specimens in the Patagonian National Center CENPAT (LJAMM-CNP) in Chubut Province. Pérez *et al.* (2011) mention one specimen from Bariloche Department, Río Negro Province (-41.1500; -71.3000) (LJAMM 3092).

In this paper we present information on additional specimens of *Liolaemus lobo* that expand the known range of the species and provide more information on its habitat and behavior.

The specimens were captured using a monofilament lasso tied to the tip of a fishing pole or dug out of tunnels where they had fled. Notes on the habitat and behavior of the collected specimens were made. High resolution photographs were taken in situ in natural habitat of the collected individuals and on a white background to emphasize coloration characters. The specimens were euthanized with sodium Pentothal (1%), fixed in formalin (10%), and later stored in ethanol (70%). The specimens were identified using the diagnostic characters in the species description, and were compared with the specimens of the *L. lobo* type series and additional specimens deposited in other collections (See Appendix 1). Morphometric measurements were made with digital calipers to the nearest 0.01 mm, we used 10 g and 20 g Pesola® scales to measure the mass while they were alive at the time of capture, and an Optech stereoscopic magnifying glass was used for scale counting and identification of morphological characters. Standard measurements and scale counts of new specimens are presented in Tables 1 and 2. Coordinates were taken with a GPS device (datum WGS84), Garmin Etrex 30™. For the preparation of the updated distribution map, we reviewed all the locality records previously described and used Google Earth Pro version 7.3.3.7699 to check the points and locations between the populations and using QGIS 3.12.3. to prepare Figure 1.

Liolaemus lobo Abdala, 2003 (Figs. 2 and 3).

During a field trip to Lolog Lake, Lacar Department, Neuquén Province, Argentina near the “Estancia los

Ñires" Country Club (-40.0863; -71.2973; elevation 894 a.s.l) (Fig. 1); P. Chafrat, V. Medina, L. Gonzalez, & H. Chafrat collected on 31 March 2018, at 16:45

hs; MPCN-H-439 (Fig. 2A), and on 1 April 2018, at 17:15 hs; MPCN-H-440 (Fig. 2B). Both were deposited in the herpetological collection of the Patagonian

Table 1. Standard measurements and scale counts of an adult specimen of *Liolaemus lobo* Abdala, 2003. Measurements are in mm, weight in gm and scale in numbers.

	MPCN-H-439	MPCN-H-440
Sex	Male	Female
Snout-vent length	69.14	60.10
Axilla-groin distance	34.07	32.11
Head length	15.24	13.13
Head width	12.02	9.57
Head height	9.78	7.87
Foot length	18.50	16.76
Tibial length	13.77	11.67
Supralabial scales	8	7
Infralabial scales	7	6
Scales around midbody	63	64
Dorsal scales	68	66
Ventral scales	104	106
Gular scales	31	30
Cloacal pores	9	0
Weight	10	7

Table 2. List of specimen of *Liolaemus lobo* Abdala, 2003, from de Estancia Tehuel Malal and Fortin Chacabuco in Los Lagos Department Neuquén Province and Cerro Bernal, Pilcaniyeu Departement Río Negro Province. Measurements are in mm and weight in g.

Specimens	Sex	Stage	Snout-vent length (SLV)	weight
MVZ-180112	Male	Adult	70	-
MVZ-180114	Male	Adult	58	-
MVZ-180115	Male	Adult	60	6
MVZ-180116	Male	Adult	67	8.2
MVZ-180117	Female	Adult	68	9.3
MVZ-186561	Female	Adult	67	-
MVZ-186562	Female	Adult	63	-
MVZ-186563	Female	Subadult	51	-
MVZ-186464	Female	Juvenile	30	-
MVZ-188785	Female	Adult	71	-
MVZ-188786	Male	Adult	69	-
MVZ-188787	Male	Adult	70	-
MVZ-188788	Male	Subadult	58	-
MVZ-188789	Female	Adult	64	-
MVZ-188790	Female	Adult	66	-
MVZ-188791	Female	Juvenile	44	2.4
MVZ-188792	Female	Adult	67	8.9
MVZ-188793	Male	Adult	60	6.1
MVZ-188794	Male	Adult	73	9.6
MVZ-200512	Male	Adult	71	-
MVZ-232149	Male	Adult	83	12.7

Museum of Natural Sciences “Juan Carlos Salgado”, General Roca, Río Negro Province. A large number of adult and juvenile individuals were observed during two hours of searching on 1 April. At this site *L. lobo* is sympatric with *Liolaemus chiliensis* (Lesson, 1830), and *Liolaemus cf. bibronii* (Bell, 1843), and the environment is similar to the habitat at the type locality. The soil is sandy with rocks and large thorny bushes. The general location is to the east of the glacial moraine that produces Lolog Lake. Elevation varies from 910 m a.s.l near the moraine to 890 m a.s.l at its eastern end. The stratigraphy is a Holocene/Upper Pleistocene deposit (Escosteguy *et al.*, 2013). The area is part of the “Distrito Occidental” of the “Provincia Fitogeográfica Patagónica” of León *et al.* (1998) and is characterized as a steppe vegetation of shrubs and bunch grasses. The most common plants include Neneo (*Azorella prolifera* (Cav.) G.M. Plunkett & A.N. Nicolas) and bunch

grasses species of *Pappostipa* (Speg.) Romasch, P.M. Peterson & Soreng, Coirón (*Festuca* Tourn. ex L.), and *Poa* L. In some sectors, the environment is highly modified by human activities, which will negatively influence this population. This record represents the northernmost documented locality for this species and extends the range of *L. lobo* 106 km northwest in a straight line from the nearest previously known occurrence record (Fig. 1).

During six field trips, between 1981 and 1996, R. D. Sage and M. I. Christie collected 21 specimens in areas close to the type locality in Los Lagos Department in Neuquén Province and in Río Negro Province that were initially recognized in field catalogue as “*Liolaemus fitzingerii*” (Duméril & Bibron, 1837). Following the original description of *L. lobo*, that species name was re-assigned to the specimens. CSA confirmed the identities of six of them as *L. lobo* from photographs of the live animals in June, 2020 (Fig. 3). The specimens are deposited in the herpetological collection at the Museum of Vertebrate Zoology, University of California, Berkeley, California (MVZ). The measurements, weight, sex and stage of these specimens can be seen in Table 2. Coordinates for these specimens were found on Google Earth Pro version 7.3.3.7699. (Fig. 1). In Los Lagos Department, sandy flat along highway, Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi (-41.0413; 71.2177; elevation 950 m a.s.l) they collected; on 10 November 1981; MVZ-180112 (Fig. 3A), MVZ-180114, MVZ-200512 (Fig. 3E) (a complete skeleton prepared). On 22 November 1981; MVZ-180115, MVZ-180116, MVZ-180117. On 8 February 1984; MVZ-186561, MVZ-186562, MVZ-186563, MVZ-186564. On 11 March 1982; MVZ-188786 (Fig. 3B), MVZ-188787, MVZ-188788, MVZ-188789, MVZ-188790. On 30 November 1982; MVZ-188791, MVZ-188792 (Fig. 3F), MVZ-188793, MVZ-188794 (Fig. 3D). In Los Lagos Department, Estancia Fortin Chacabuco, 7 km N they collected: on 11 March 1982; MVZ-188785. One-third (33%) of the 21 lizards collected in the 1980s, had broken and regenerated tails. Adults have a higher frequency (42%) than subadults (22%).

The records at the Estancias Tehuel Malal and Chacabuco are 3-10 km W of the type locality in Los Lagos Department, Neuquén Province. They are historical records of a large population and provide invaluable data for future ecological and conservation studies of this species and of climate change in northern Patagonia and its effect on

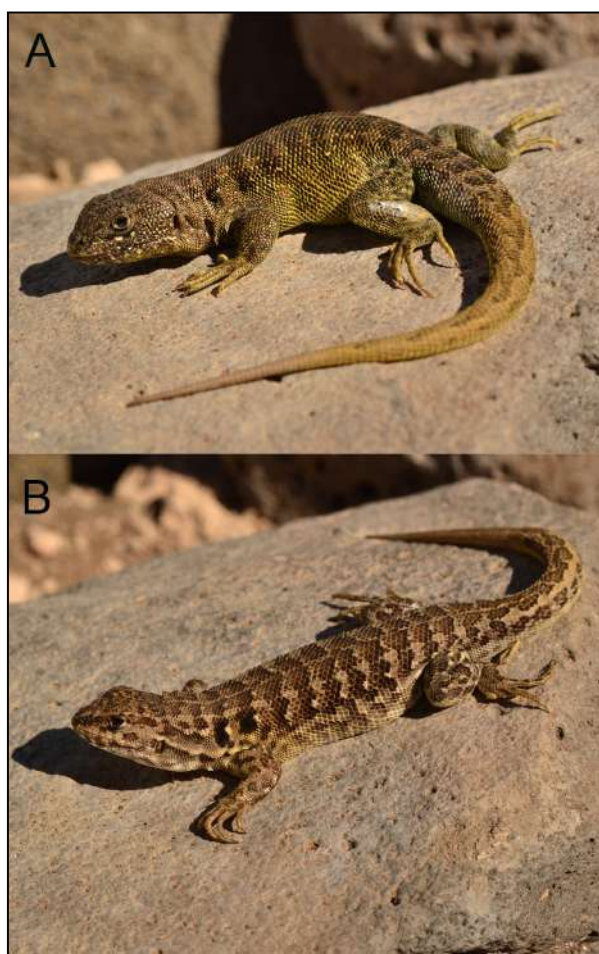


Figure 2. A: *Liolaemus lobo*, adult male (MPCN-H-439) from Lolog Lake, Lacar Department, Neuquén Province, Argentina. B: *Liolaemus lobo*, adult female (MPCN-H-440) from Lolog Lake, Lacar Department, Neuquén Province, Argentina. Photographs by P. Chafrat.

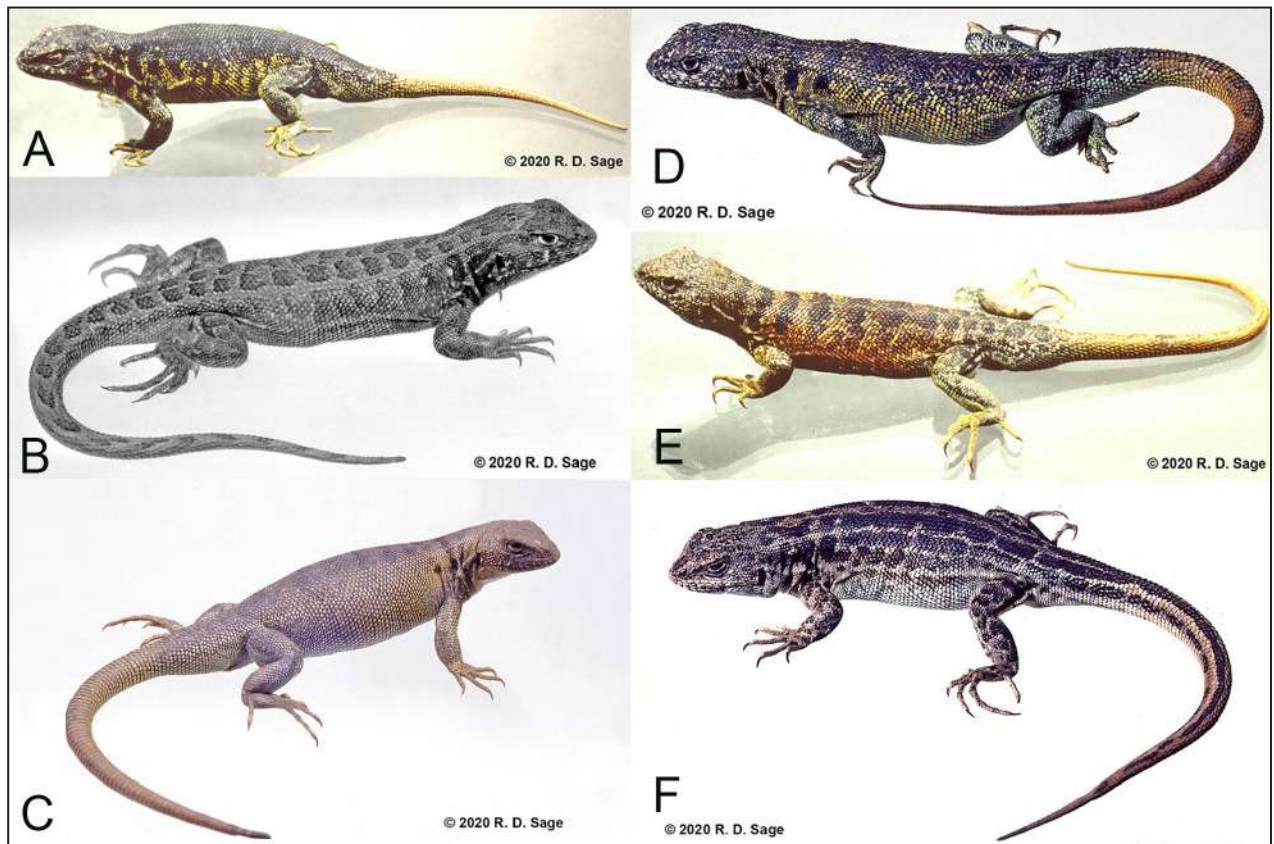


Figure 3. **A:** *Liolaemus loboii*, adult male (MVZ-180112) from Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi, Los Lagos Department, Neuquén Province, Argentina. **B:** *Liolaemus loboii*, adult male (MVZ-188786) from Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi, Los Lagos Department, Neuquén Province, Argentina. **C:** *Liolaemus loboii*, adult male (MVZ-232149) along Provincial Route 80, 6 km E, 2 km N Cerro Bernal, Pilcaniyeu Department, Río Negro Province, Argentina. **D:** *Liolaemus loboii*, adult male (MVZ-188794) from Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi, Los Lagos Department, Neuquén Province, Argentina. **E:** *Liolaemus loboii*, adult male (MVZ-200512) from Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi, Los Lagos Department, Neuquén Province, Argentina. **F:** *Liolaemus loboii*, gravid adult female (MVZ-188792) from Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi, Los Lagos Department, Neuquén Province, Argentina. Photographs by R.D.Sage

biodiversity, especially of reptiles and amphibians. At this site *L. loboii* is sympatric with *Liolaemus* cf. *bibronii*, *Liolaemus* aff. *elongatus*, and *Diplolaemus sexcinctus* (Cei *et al.*, 2003), and the environment is like the type locality habitat. During the RDS field work, he observed with one exception, all of the *L. loboii* seen or collected were on the same sandy plain as the type series. Basking began at about 11:00 hs and continued until at least 18:00 hs. Among the specimens, three females, 44, 62, and 63 mm SVL, were immature, with unpigmented ova, <1mm in diameter. Two females, 64 and 66 mm SVL, collected in late summer (March, 1982), had partially pigmented ova, 2 mm in diameter, suggesting that they were becoming reproductively active. Three other specimens were mature females, one of 67 mm SVL had 4 enlarged ova 4 mm in diameter and convoluted oviducts, another had 4 shelled eggs

measuring 13x6 mm. Both of these females were collected at the end of November, 1981 and 1982. One female of 67 mm SVL, collected in February 1984, had unpigmented ova 1 mm in diameter, but the oviducts were convoluted. She probably had laid her eggs earlier in the season, as indicated by the convoluted oviducts, but had not yet begun to ripen new ova for the next breeding season. Four of the males, ranging from 58 to 67 mm SVL, had left testes that measuring 3x2 mm. Three males of 70, 70, and 71 mm SVL had left testes that were 9x7 mm, 9x7 mm, and 7x5 mm in size, respectively. Two of the males, 70 and 71 mm SVL, that were collected in November had sperm in the epididymis, but one of 70 mm SVL collected in March did not. The left testis of the largest male, 73 mm SVL, measured only 4x3 mm even though it was also collected in November 1982. However, sperm were present in the

epididymis of this animal. At the Río Negro locality, the 83 mm SVL male also had a small left testis, 4x2 mm, suggesting that the sizes of the testes had regressed during the post-breeding season, as found by Halloy *et al.* (2013) in *L. crepuscularis* Abdala & Díaz-Gomez, 2006.

The type locality site (near the intersections of Nacional Routes 237 and 40/231) is in a SW-NE sandy plain located east of the terminal moraine that produces Nahuel Huapi Lake. Width of the plain is approximately 4 km at the southwestern end and 0.8 km at the northeastern end, which is approximately 6.5 km from the moraine. Elevation ranges from 790 m at the NE end to about 820 m near the moraine. The stratigraphy is Holocene alluvial deposits (Giacosa *et al.*, 2005). The area is part of the “Distrito Occidental” of the “Provincia Fitogeográfica Patagónica” of León *et al.* (1998) and according to a biogeography analysis by Andrade-Díaz *et al.* (2017) *Liolaemus lobo* was placed in an area of endemism (Area 23).

In Río Negro Province, Pilcaniyeu Department, along Provincial Route 80, 6 km E, 2 km N Cerro Bernal (-41.234158; -71.037220, elevation 1100 m a.s.l.) Richard D. Sage & Michael I. Christie collected: 1 adult male, SVL 83 mm, weight 12.7 gm, on 12 December 1996; MVZ- 232149 (Fig. 3C). This locality is on a slope that slowly ascends from the Pampa del Nahuel Huapi to the divide (alt. 1190 m a.s.l.) separating the drainages of the Río Limay (N) and the Río Pichi Leufú (S). The stratigraphy is older than at the type locality, classified as Upper Plio-Pleistocene glacial deposits, composed of boulders, gravel, sand, and muds (Giacosa *et al.*, 2005). However, the collecting site is at the western edge of a lens of fine sand that is 2.5 km in length and sloping downward to the stream that empties into the meadows of the Pampa del Nahuel Huapi. The vegetation is similar to that at the type locality, composed of Neneo bushes and bunch grasses. This record represents the southernmost documented locality of this species and extends the range of *L. lobo*, 25 km southeast in a straight line from the nearest previously known occurrence record (Fig. 1). At this site *L. lobo* is sympatric with *Liolaemus* cf. *bibronii*, *Liolaemus rothi*, and *Diplolaemus sexcinctus*. The species now has a documented linear dispersion of 132 km, stretching from Lolog Lake, Neuquén Province, to near Cerro Bernal, in Río Negro Province, and according to the data provided in this work, the elevation range for the species is

from 790 to 1100 m a.s.l.

The collections of RDS from the twentieth century suggest that the Río Negro animals reach a larger size (at least 83 mm SVL) than those at the Los Lagos site (73 mm SVL). In his description of the 16 specimens in the type series, Abdala (2003) reports that the largest specimen was 72,7 mm SVL, similar in size to the 1980's animals. The 1980's, Los Lagos collection suggests that there is some sexual size dimorphism, with the largest females at 68 mm SVL and the largest male at 73 mm SVL. Females at the Los Lagos site are immature to 63 mm SVL and males to 67 mm SVL, suggesting that size onset towards maturity is also sexually dimorphic. The male-larger-than-female size dimorphism in *L. lobo* follows the trend in another set of species in the “*Liolaemus boulengeri*” group (Cabrera *et al.*, 2013), where 16 of the 22 species that they studied the males were larger than the females.

The conservation state was considered as Not Endangered by Abdala *et al.* (2012b). But, the IUCN (2017) declared it to be Endangered due to a small geographical range, the continued degradation of its habitat, and a poor understanding of its biology (environmental requirements, and ecology and physiology). The new populations reported in this paper show that *L. lobo* has a much larger geographical range than understood up to this moment, occurring in river drainages that are on the northern and southern sides of the large, Río Limay. The species does have specific habitat requirements (*i.e.*, flatlands with sandy soils), which are attractive for forest plantations and housing developments. The type locality is within Parque Nacional Lanín, and thus has some environmental protection. Nevertheless, habitat degradation continues at the Lolog Lake site, and global climate changes are known to be having deleterious effects on lizard populations (Gibbons *et al.*, 2000).

The present records provide a significant expansion to the geographic distribution of *Liolaemus lobo*, along with a better understanding of its preferred habitat types, and some information about its behaviour and reproduction.

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Appendix 1

Specimens examined and the locality where they were collected.

Liolaemus lobo: FML 14802: (Holotype) Intersection of national routes 237 and 231. Los Lagos Department. Neuquén Province. FML 7770, 7780-82, 7789: (Paratypes) Intersection of national routes 237 and 231, Los Lagos

Department, Neuquén Province, Argentina. FML 13253-56 (Paratypes): Same data as the previous one. FML 14796-801 (Paratypes): Same data as the previous one. LJAMM 3092: Bariloche Department, Bariloche (41°09' S, 71°18' W). MPCN-H-439-440: near Country Club "Estancia los Ñires", Lolog Lake, Lacar Department, Neuquén Province, Argentina (-40.0863 S -71.2973 W, 894 m a.s.l.). MVZ-180112, 180114-17, 186561-64, 188786-94, 200512: Neuquén Province, Los Lagos Department, sandy flat along highway, Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi (-41.0413 S - 71.2177 W, 950 m a.s.l.). MVZ-188785: Neuquén Province, Los Lagos Department, Estancia Fortín Chacabuco, 7 km N. MVZ- 232149: Río Negro Province, Pilcaniyeu Department, along Provincial Route 80, 6 km E, 2 km N Cerro Bernal (-41.2341° S, -71.0372° W, 1100 m a.s.l.).

Liolaemus purul: FML 24153: (Holotype) 6 km N of San Ignacio, on the way to Zapala National Route 40, Collón Curá Department, Neuquén Province, Argentina. (-39.8484 S -70.6648 W. 1071 m a.s.l.). FML 24154-163: Same locality and data of the holotype.

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