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Current and Potential Distribution of the Endangered Endemic Lizard *Liolaemus cuyumhue*: Implications for Conservation

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Abstract.—**To identify the threats a species is facing, the first step is to locate its populations and their distribution. When other ecological studies are not possible, knowing the distribution of a species and if possible, inferences about its density, can be enough to make informed management decisions for conservation priorities. In addition, with up-to-date knowledge of the geographic distribution, it is possible to carry out analysis of potential distributions through Ecological Niche Modelling (ENM). Here, we address for the first time the study of the distribution of a critically endangered lizard, the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*). We surveyed probable habitats of *L. cuyumhue*, estimated an index of population density in three areas where the species occurs, evaluated the nature of local habitat degradation in these areas, and interpolated its potential distribution. We surveyed 52 locations over the southernmost part of the Bajo de Añelo area and found *L. cuyumhue* at 16 sites. We also estimated differences in population density indexes among sites (Sites 2 and 1 and Sites 2 and 3), and among these, Site 2 had the highest population density of lizards and was characterized by more sources of disturbance. We confirmed that *L. cuyumhue* is an obligate endemic characterized by small populations, few occurrence records, and limited suitable habitats. We stress the need for urgent protection of all habitats that support isolated populations of this species.**

Key Words.—Añelo Sand Dunes Lizard; biogeography; ecological niche modeling; habitat suitability; niche

Introduction

There is extensive evidence of global decline in vertebrate populations (Gibbons et al. 2000; Light and Marchetti 2007; Beebee et al. 2009; Jones and Cresswell 2010; Hoffman et al. 2011). Approximately 200 vertebrates have disappeared in the past 100 y (Ceballos et al. 2017), and 15% of these species were reptiles (International Union for the Conservation of Nature 2021). Additionally, some studies suggest that between 15% and 44% of reptiles of the world are threatened with extinction (Böhm et al. 2013; Ceballos et al. 2015). Habitat loss, fragmentation, human overexploitation, introduced invasive species, emerging diseases, environmental pollution, and climate change all increase risks of population declines and extinctions (Bosch et al. 2007; Sinervo et al. 2010; Böhm et al. 2016).

Identification of threats to any species first requires locating its populations, and then assessing what factor(s) threaten the species. When detailed ecological studies are not possible, at least knowing the distribution of a species, and if possible, its abundance, can be enough to make informed management decisions for conservation priorities (Moreira-Muñoz et al. 2012; Guisan et al. 2013; Sunny et al. 2017; Rodríguez-Rodríguez et al. 2018). Further, knowledge of the species current and former geographic distribution allows assessment of potential distribution through Ecological Niche Modeling (ENM). Refinement of a species historical distribution may then permit a projection of possible future shifts in the species geographic range (Moreira-Muñoz et al. 2012). Modeling the potential geographic distributions of a species by relating observed occurrence localities to environmental data have been widely applied across a range of biogeographical analyses (Guisan and Thuiller 2005; Van Schinger et al. 2014; Yi et al. 2016; Zhao et al. 2020). This approach aims to estimate the realized coarse-resolution environmental requirements of a species, which can then be projected onto real-world landscapes to identify regions in which the requirements of the species are manifested (Saupe et al. 2012). Geographical regions presenting similar environments to where the species has been observed can thus be identified (Pearson et al. 2007). Consequently, ENM can

Figure 1. (A) Adult male and (B) habitat of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*). (Photographed by Victoria Brizio).

inform conservation decisions such as designing surveys for new populations and making spatial prioritization decisions for management actions, regulatory decision-making, and compliance, among other decisions (Sofaer et al. 2019; Simoes et al. 2020).

Here, we address for the first time the distribution of a critically endangered lizard species of the *Liolaemus wiegmannii* group (Etheridge 2000; Villamil et al. 2019); the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*; Fig. 1). This species is known only from two localities in a small, isolated sand-dune system in the Bajo de Añelo east-central region of Neuquén province, northern Patagonia, Argentina (Avila et al. 2009). It remains poorly known since its description, but a recent study of its thermal biology highlights its vulnerability to global warming (Brizio et al. 2021). Individuals of *L. cuyumhue* are observed only on bare or sparsely vegetated Mediterranean Aeolian dunes characterized by extensive areas of open sand (Fig. 1). The cryptic coloration and motionless behavior of the lizard, coupled with a very fast sand-diving behavior, enable it to avoid detection or escape possible predators. Across virtually all of it restricted distribution, the habitat of this species is degraded due to extensive livestock ranching (primarily Goats, *Capra hircus*, but some Cattle, *Bos taurus*, and Horses, *Equus caballus*), and poorly regulated gas and oil drilling (Mazzoni and Vazquez 2009). These are constant threats for *L. cuyumhue* and its habitat. New rigs, pipelines, power lines, and roads are opened regularly (Fig. 2), further modifying or destroying the few remaining suitable habitats (Avila 2016). The conservation of *L. cuyumhue* is of great concern (Avila 2016; Brizio et al. 2021) and an action plan that ensures the long-term viability of the species is urgently needed. In this study we: (1) surveyed the probable habitats of *L. cuyumhue* along the Bajo de Añelo regions to locate new populations/update its geographic distribution; (2) estimated an index of population density in three areas where the species occurs and evaluated the nature of local habitat degradation and potential threats in each of these areas; and (3) used occurrence records to interpolate the potential distribution of *L. cuyumhue*.

Materials and Methods

Study site.—We carried out our study in the Bajo de Añelo basin, located in the center-east of Neuquén province, Argentina (37.4° to 38.5°S and 68.4° to 69.8°W). The Bajo de Añelo Basin comprises the lowest area of the province (230 m elevation) covering an area of 9,000 km^2 within the Monte Desert Region (Roig et al. 2009). The climate is temperate arid to semi-arid, with a mean annual temperature of 14.2° C and a mean annual precipitation of 137.2 mm, occurring mainly in winter and spring (Busso and Bonvissuto 2009). The vegetation presents a marked physiognomic-floristic homogeneity, characterized by being a shrubby steppe with perennial foliage represented by shrubs in the genus *Larrea* with little herbaceous cover and a scarcity of grasses and trees (Leon et al. 1998; Roig et al. 2009).

Data collection.—We traveled to the Bajo de Añelo during the activity season of the lizard, from January 2003 through December 2020. We surveyed 52 locations, all of which were separated from each other by at least 1 km. We could not survey some private lands where oil and gas extractions were in progress. We surveyed only the low elevation Bajo de Añelo habitats, those between 230 to 600 m, higher elevations did not have the dune environments used by *L. cuyumhue*. We actively searched 1000–1700 in the spring and 0800–1200 and 1700–2000 in the summer.

We selected three sites to estimate the population status of *L. cuyumhue*, approximately 5 km apart from each other, with all with a confirmed presence based on the 52 surveyed locations. We placed eight cross pitfall traps at each site and spaced these about 25 m apart along the dunes. We checked each pitfall trap monthly throughout the spring and summer (20 September to 20 March) for three consecutive years. We toe-clipped all lizards with an individual ID number based on the

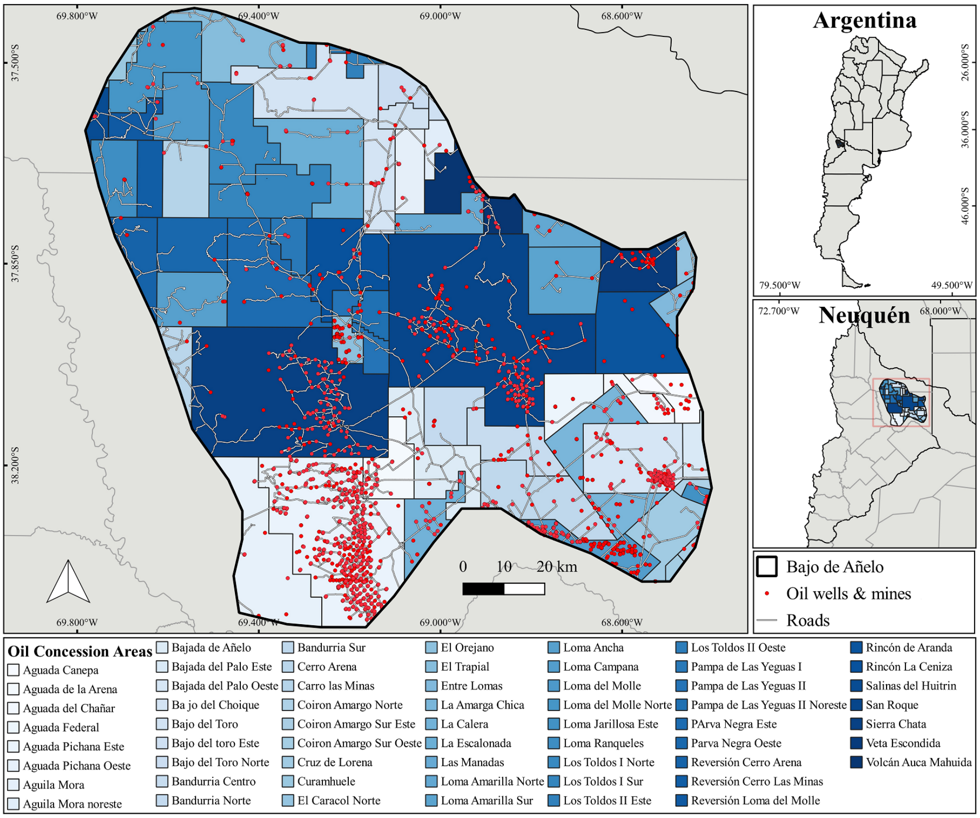

Figure 2. The study area Bajo de Añelo, Argentina, with the various oil concession areas shown in blue and oil wells and mines shown as red dots. (Data from http://hidrocarburos.energianeuquen.gov.ar/?page_id=1978)

code described by Woodbury (1956). Loss of a few toes does not have significant deleterious effects to terrestrial lizards (Borges-Landáez and Shine 2003). We calculated a standardized index of population density by dividing the total number of sighted lizards by the particular area (expressed as individuals[ind]/ha). We also recorded the following sources of disturbance at each site (as described by Rocha et al. 2009): (1) heavy traffic; (2) presence of limited oil well activity; (3) removal of sand and dune vegetation for oil activities; (4) presence of construction machinery on the dunes; (5) presence of vehicle tracks on the dunes; and (6) presence of cattle.

Data analysis.—We tested data for normality using the Shapiro-Wilk Test, and for homogeneity of variances using Levene's Test. To analyze the effect of site on lizard density, we used a Linear Mixed Model (LMM) with a normal distribution. We performed *post hoc* pairwise comparisons (Tukey's Test) between levels for the site effect. Using the locations of where we found lizards, we also estimated the Area of Occupancy (AOO), a measure of the area in which the species occurs, and the Area of Extension (AOE), a measure of the geographic range size of the species, using the GeoCAT (Geospatial Conservation Assessment Tool; Batchman et al. 2011).

To identify the potential distribution area of *L. cuyumhue*, we analyzed the presence data with the Wallace software (Kass et al. 2018), an R-based GUI ecological modeling algorithm to build, evaluate, and visualize models of niches and species distributions. This program is available as the R package Wallace on CRAN, with a development version on Github. We selected 16 environmental variables from WorldClim Bioclims, excluding the four layers that combine precipitation and temperature information into the same layer (Bio 8, Bio 9, Bio 18 and Bio 19; Table 1). The combinations we excluded have shown odd spatial anomalies in the form of odd discontinuities between neighboring pixels (Escobar et al. 2014). To avoid multicollinearity, we estimated the correlations among environmental variables (Appendix Table 1). Each variable from a highly correlated pair ($r^2 > 0.8$) was retained/rejected according to our knowledge. This led to retaining eight ecologically relevant variables (Table 1).

Because at the resolution of 1 km (30 arcseconds) all of our variables were correlated, we worked with the 5 km resolution (2.5 arcminutes), and to avoid spatial autocorrelation (i.e., locations close to each other exhibit more similar values than those further apart), we filtered all presence points that were < 5 km

Table 1. Environmental variables available at WorldClim Bioclims that we used for a correlation analysis. The variables highlighted in bold are the ones that were not correlated with each other and were used for the modeling.

Environmental Variables	
BIO1 =	Annual Mean Temperature
BIO2 =	**Mean Diurnal Range (Mean of monthly [max temp - min temp])**
BIO3 =	**Isothermality (BIO2/BIO7) (×100)**
BIO4 =	Temperature Seasonality (standard deviation ×100)
BIO5 =	Max Temperature of Warmest Month
BIO6 =	Min Temperature of Coldest Month
BIO7 =	**Temperature Annual Range (BIO5-BIO6)**
BIO10 =	**Mean Temperature of Warmest Quarter**
BIO11 =	Mean Temperature of Coldest Quarter
BIO12 =	**Annual Precipitation**
BIO13 =	Precipitation of Wettest Month
BIO14 =	Precipitation of Driest Month
BIO15 =	**Precipitation Seasonality (Coefficient of Variation)**
BIO16 =	**Precipitation of Wettest Quarter**
BIO17 =	**Precipitation of Driest Quarter**
ELEV =	Elevation

apart. We selected a modeling procedure based on the jackknife technique, appropriate for low numbers of observations (Pearson et al. 2007). Finally, we built the model through MAXENT with 10,000 iterations of data randomizations and selected the best fit following Warren and Seifert (2011) and Elith et al. (2011). We evaluated ENM performance with the Omission Rate (OR10%), the maximum test Area Under the Receiver Operator Curve (AUC_{Test}) for the averaged models, and the corrected Akaike Information Criterion (AICc).

Results

We found *Liolaemus cuyumhue* in 16 of the 52 surveyed locations (Fig. 3; Appendix Table 2), all of which were within 231 and 540 m elevation with an AOE of 730,827 km^2 and AOO of 16,000 km^2. The estimated population density indexes varied significantly across the three locations ($F_{2,40} = 5.29$, $P < 0.009$). We found significant differences between Site 2-Site 1 Tukey's *post hoc* test = -0.211, $P = 0.016$) and Site 2-Site 3 (Tukey's *post hoc* test = 0.196, $P = 0.026$). Site 2 supported the highest lizard density, 8.4 ind/ha, and had all disturbance sources except heavy traffic. Site 1 had the lowest density with 4.0 ind/ha, along with heavy traffic, presence of vehicle tracks on the dunes, and cattle as disturbance sources. Site 3 had a slightly higher density index than Site 1 of 4.3 ind/ha with only presence of vehicle tracks on the dunes and cattle as disturbance sources. The most important variables in determining habitat suitability of *L. cuyumhue* were isothermality (bio3), mean temperature of the warmest quarter (bio10), and precipitation of the wettest quarter (bio16; Table 2). The potential distribution map (Fig. 4) shows the highest probability (red) and zero probability (blue) habitable areas, and intermediate habitats (identified by the remaining colors).

Discussion

Our data show that the habitat of *L. cuyumhue* is restricted to small, isolated patches within a large area, heavily impacted by human activity. One unexpected result of this study is the surprisingly high density of lizards at one site (Site 2), which is embedded within the region with the highest number of disturbances. In contrast, the sister species, the Sand Dune Lizard (*L. multimaculatus*), endemic to coastal isolated sand dunes, has smaller populations within areas with high levels of degradation (Vega et al. 2000; Rocha et al. 2009; Kacoliris et al. 2011). Considering the presumably low quality of the Site 2 habitat, further study is needed to see if this region function as what is called an ecological trap (Heinrichs et al. 2018). Many ecosystems may provide habitats less than optimal for species populations (Railsback et al. 2003). As such, population density alone cannot be used to assess the conservation status of a species, and basic natural history data, demographic trends, and spatial dynamics are needed (Hawlena et al. 2010). Furthermore, density values for *L. cuyumhue* in Sites 1 and 3 were similar to those obtained for its sister species, *L. multimaculatus* (4.1–5.2 ind/ha; Kacoliris et al. 2009). Also, habitat mean thermal quality values (d_e) were also similar for the population densities of *L. cuyumhue* at Site1 (Brizio et al. 2021) and for *L. multimaculatus* at the Mar Chiquita Reserve (Stellatelli et al. 2020). These sister species are also morphologically and behaviorally very similar (Avila et al. 2009).

Different population densities are known in other closely related species of *Liolaemus*, including the Dune Lizard (*L. arambarensis*; 2–27 ind/ha; Martins et al. 2017), *L. wiegmannii* (no common name; 100 ind/ha; Martori et al. 1998), and the Sand Lizard (*L. lutzae*; 41–114 ind/ha; Rocha 1998). Additionally, population densities in other desert-dwelling lizards are generally lower; examples include several North American species: the Texas Horned Lizard (*Phrynosoma cornutum*; 5.0 ind/ha; Endriss et al. 2007); the Blunt-nosed Leopard Lizard (*Gambelia sila*; 16.0 ind/ha; Germano and Williams 2005); the Western Whiptail (*Aspidoscelis tigris*; 7.34 ind/ha; Furnas et al. 2019); the Common Side-blotched Lizard (*Uta stansburiana*; 3.88 ind/ha; Furnas et al. 2019); and the Zebra-tailed

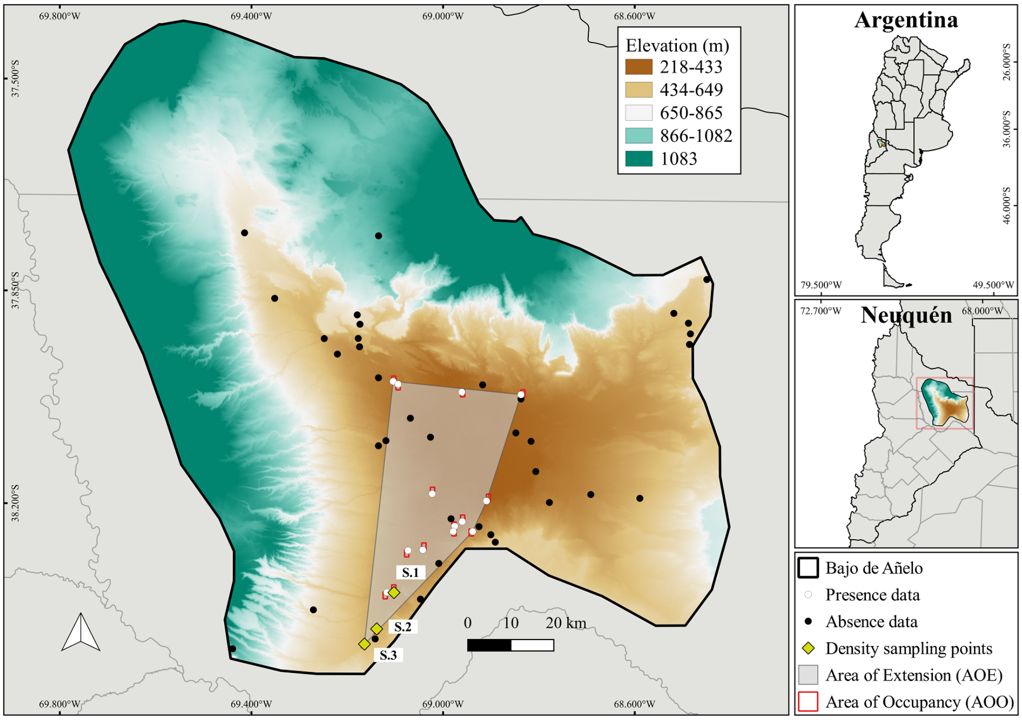

Figure 3. Distribution of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*) in Argentina. Black dots show all the surveyed locations, white dots presence data, S1, S2, S3 are the density sampling points, brown polygon shows the extension area (AOE; a measure of the geographic range size of the species), and the small red rectangles the occupancy area (AOO; a measure of the area in which the species occurs).

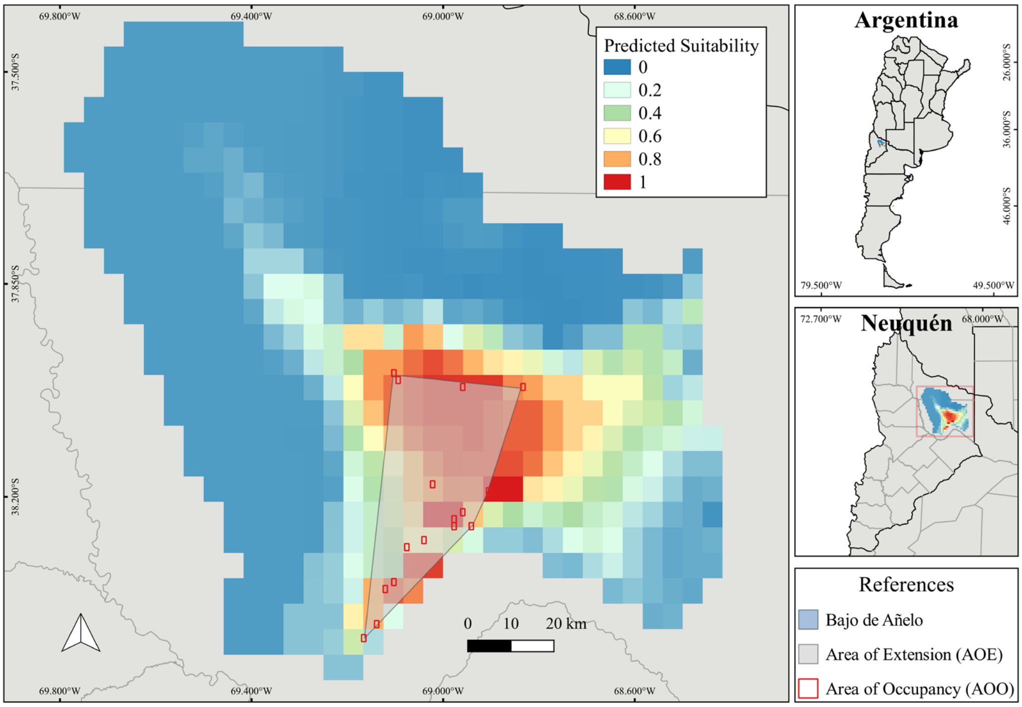

Figure 4. Predicted potential geographic distribution map of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*) in Argentina based on presence records (red rectangles) and climatic variables.

Table 2. Performance of the top 10 models of potential distribution of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*) with the selected model in bold. The models are named with the number of the regularization multiplier and the family functions that they belong: Hinge (H); Linear (L); or Quadratic (Q). The table shows the values of Omission Rate (OR10%), the maximum test Area Under the Receiver Operator Curve (AUC_{Test}) for the averaged models, the Standard Deviation for it (AUC_{Test} SD), and the corrected Akaike Information Criterion (AICc).

Models	OR10%	Average AUC_{Test}	AUC_{Test} SD	AICc	Parameters
2.5_fc.H	**0.222**	**0.960**	**0.032**	**96.871**	**3**
1_fc.L	0.333	0.968	0.026	99.014	4
3.5_fc.H	0.222	0.955	0.038	101.795	3
4_fc.LQ	0.222	0.938	0.059	103.217	2
4_fc.H	0.222	0.953	0.039	103.441	3
3.5_fc.L	0.222	0.938	0.059	103.728	2
4_fc.L	0.222	0.935	0.059	105.732	2
3_fc.LQH	0.222	0.955	0.037	106.365	4
3_fc.H	0.222	0.956	0.035	106.876	4
3.5_fc.LQH	0.222	0.953	0.038	109.441	4

Lizard (*Callisaurus draconoides*; 1.02 ind/ha; Furnas et al. 2019). These differences could be due to different phylogenetic histories, and/or intrinsic characteristics of North American desert ecosystems, such as precipitation, solar radiation, low soil fertility, and low productivity (Maestre et al. 2015; Hoover et al. 2020). Further, the biogeographic history and geographic extent of each desert may explain these density values (Agarwal et al. 2015), as well as anthropic activities. For example, Furnas et al. (2019) reported low densities for *C. draconoides* of 1.2 ind/ha in the Mojave Desert as a result of human activities (urban, agricultural, transportation, and mining-related development).

Despite the near-absence of natural history data for this species, we were able to collect basic absence/presence data for this study. There are a number of avenues for improving this work, however, should more data become available. Further, other factors not considered in our modeling (thermal envelopes, soil geomorphology, biotic interactions, geographic barriers, among others) imply that species rarely occupy all environmentally suitable habitats (Anderson et al. 2002; Svenning and Skov 2004; Araújo and Pearson 2005). For these reasons, niche-based distribution model data must be interpreted conservatively (Pearson and Dawson 2003; Soberón and Peterson 2004; Phillips et al. 2006), but bioclimate models can provide a useful starting point when applied to suitable species and at appropriate spatial scales. In many cases, like ours, these models provide the best available guide for policy making at the current time (Hannah et al. 2002). The potential distribution map for *L. cuyumhue* that we included shows the center of the highest predicted suitability area (red and orange colored) without any presence data. This corresponds to the lowest part of the Bajo de Añelo, where numerous channels drain from ravines to form salt flats and permanent lagoons (Basaldúa, 2018). The dune environments that *L. cuyumhue* inhabits are near these salt flats and lagoons, between the presence data points and the 0.2 predicted suitability. We consider these areas extremely important for conservation because they harbor a rich and unique diversity, not only of reptiles, but also for little-studied groups such as arthropods (Roig-Juñent et al. 2001), birds (Rundel et al. 2007), and mammals (Ojeda et al. 2002).

Because *L. cuyumhue* was not formally described before the start of gas and oil development in the region, we cannot know if it has already been impacted by these activities, but it is strictly endemic to these geographically restricted habitats and characterized by low population densities and few occurrences. We urge immediate protection of these small but unique habitats, as a recent study showed how rapidly habitat alteration in this dunes environment can lead to local extinction of specialist endemic species like the Shoulder Tree Iguana (*Liolaemus scapularis*; Cabrera 2021). Similarly, the distribution of a North American dune-dwelling Dunes Sagebrush Lizard (*Sceloporus arenicolus*) was negatively affected by oil and gas development (Smolensky and Fitzgerald 2011; Walkup et al. 2017). In another example, Vega et al. (2000) studied *L. multimaculatus* and the Graceful Tree Iguana (*L. gracilis*) before and after the construction of a road; 7 y after the disturbance, patches of vegetation destroyed by construction had not recovered, which accelerated soil erosion, followed by a notable decrease in the abundance of *L. multimaculatus.*

Given the above studies, we urge land protection as a priority to maintain a viable population size for this species, and its meta-population structure by protecting the connectivity of its so-called island habitats. Similar recommendations have been suggested for similar cases (Dixo and Metzger 2009; Kacoliris et al. 2019). Future research activities should focus on other basic life-history attributes, including feeding, reproduction, population viability, and habitat connectivity, as the scientific basis for implementation of appropriate conservation strategies for these unique habitats.

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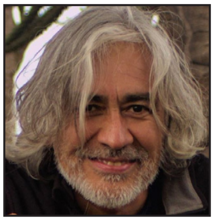

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Appendix Table 1. Results of the correlation analysis used to select environmental variables used to determine the distribution of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*) in Argentina. **S**ignificant correlations are in bold.

	BIO1	BIO2	BIO3	BIO4	BIO5	BIO6	BIO7	BIO10	BIO11	BIO12	BIO13	BIO14	BIO15	BIO16	BIO17	ELEV
BIO1	1.000	0.053	-0.758	**0.880**	**0.983**	**0.918**	0.695	**0.998**	**0.991**	0.132	-0.132	0.335	-0.367	-0.221	0.423	**-0.983**
BIO2	0.053	1.000	0.452	0.193	0.227	-0.217	0.655	0.077	0.012	0.540	0.418	0.494	0.016	0.391	0.483	0.101
BIO3	-0.758	0.452	1.000	-0.785	-0.667	-0.703	-0.378	-0.770	-0.717	0.006	0.410	-0.152	0.544	0.440	-0.235	**0.828**
BIO4	**0.880**	0.193	-0.785	1.000	**0.902**	0.644	**0.866**	**0.910**	**0.808**	0.341	-0.177	0.498	-0.584	-0.228	0.584	**-0.853**
BIO5	**0.983**	0.227	-0.667	**0.902**	1.000	**0.853**	0.799	**0.987**	**0.964**	0.222	-0.065	0.412	-0.362	-0.154	0.499	**-0.942**
BIO6	**0.918**	-0.217	-0.703	0.644	**0.853**	1.000	0.369	**0.893**	**0.956**	-0.141	-0.181	0.083	-0.181	-0.273	0.166	**-0.940**
BIO7	0.695	0.655	-0.378	**0.866**	0.799	0.369	1.000	0.730	0.617	0.560	0.093	0.639	-0.437	0.041	0.699	-0.596
BIO10	**0.998**	0.077	-0.770	**0.910**	**0.987**	**0.893**	0.730	1.000	**0.980**	0.162	-0.141	0.365	-0.404	-0.226	0.454	**-0.978**
BIO11	**0.991**	0.012	-0.717	**0.808**	**0.964**	**0.956**	0.617	**0.980**	1.000	0.060	-0.122	0.273	-0.294	-0.217	0.358	**-0.977**
BIO12	0.132	0.540	0.006	0.341	0.222	-0.141	0.560	0.162	0.060	1.000	0.718	0.595	0.091	0.726	0.620	-0.049
BIO13	-0.132	0.418	0.410	-0.177	-0.065	-0.181	0.093	-0.141	-0.122	0.718	1.000	0.119	0.728	**0.977**	0.111	0.193
BIO14	0.335	0.494	-0.152	0.498	0.412	0.083	0.639	0.365	0.273	0.595	0.119	1.000	-0.508	**0.093**	**0.932**	-0.236
BIO15	-0.367	0.016	0.544	-0.584	-0.362	-0.181	-0.437	-0.404	-0.294	0.091	0.728	-0.508	1.000	0.726	-0.534	0.353
BIO16	-0.221	0.391	0.440	-0.228	-0.154	-0.273	0.041	-0.226	-0.217	0.726	**0.977**	0.093	0.726	1.000	0.089	0.274
BIO17	0.423	0.483	-0.235	0.584	0.499	0.166	0.699	0.454	0.358	0.620	0.111	**0.932**	-0.534	0.089	1.000	-0.331
ELEV	**-0.983**	0.101	**0.828**	**-0.853**	**-0.942**	**-0.940**	-0.596	**-0.978**	**-0.977**	-0.049	0.193	-0.236	0.353	0.274	-0.331	1.000

Appendix Table 2. Coordinates of the sampling points with confirmed and unconfirmed presence of the Añelo Sand Dunes Lizard (*Liolaemus cuyumhue*).

Point	Longitude	Latitude	Presence
1	-68.96000	-38.23028	YES
2	-69.02278	-38.18469	YES
3	-69.10433	-37.99994	YES
4	-69.16417	-38.43139	YES
5	-68.90933	-38.19638	YES
6	-68.96078	-38.01753	YES
7	-68.83739	-38.02177	YES
8	-69.09376	-38.00466	YES
9	-68.93836	-38.24660	YES
10	-69.13862	-38.40606	YES
11	-69.10039	-38.34532	YES
12	-69.11733	-38.34626	YES
13	-69.04240	-38.27668	YES
14	-69.07313	-38.27760	YES
15	-68.97569	-38.23788	YES
16	-68.97885	-38.24653	YES
17	-69.00900	-38.29881	NO
18	-69.43928	-38.43850	NO
19	-69.14169	-38.42242	NO
20	-69.27075	-38.37483	NO
21	-69.04719	-38.35741	NO
22	-68.89103	-38.26406	NO
23	-68.90033	-38.25180	NO
24	-68.92495	-38.23855	NO
25	-68.98342	-38.22564	NO
26	-68.77811	-38.19886	NO
27	-68.58930	-38.19208	NO
28	-68.69173	-38.18589	NO
29	-68.80653	-38.14815	NO
30	-69.13489	-38.10583	NO
31	-68.81638	-38.09850	NO
32	-69.11931	-38.09742	NO
33	-69.02633	-38.09173	NO
34	-68.84814	-38.08466	NO
35	-69.06825	-38.06047	NO
36	-68.83739	-38.02894	NO
37	-68.91744	-38.00572	NO
38	-69.13483	-37.99401	NO
39	-69.22055	-37.95501	NO
40	-69.17439	-37.94306	NO
41	-68.48568	-37.93914	NO
42	-69.17719	-37.92919	NO
43	-68.48375	-37.92175	NO
44	-68.48786	-37.90422	NO
45	-69.17919	-37.89044	NO
46	-68.51833	-37.88797	NO
47	-68.44942	-37.83222	NO
48	-69.13472	-37.76000	NO
49	-69.41440	-37.75512	NO
50	-69.35146	-37.86316	NO
51	-69.17350	-37.90586	NO
52	-69.24806	-37.92944	NO