

# ASSESSING THE PRESENCE OF A BURROWING OWL (*ATHENE CUNICULARIA*) POPULATION AT THE SOUTHERN CONTINENTAL LIMIT OF ITS DISTRIBUTION, SANTA CRUZ PROVINCE, PATAGONIA, ARGENTINA

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**ABSTRACT.**— The historical continental distribution of the Burrowing Owl (*Athene cunicularia*) in Argentina included Santa Cruz province. However, for almost a century its presence there was hypothetical, based on a few, sometimes even erroneous, published records. Its precise distribution and status were unknown. In the present study, using a combination of personal observations and surveys, critical literature review, searches in online databases (EcoRegistros and eBird), scrutiny of Facebook pages and group posts focused on Argentine and Patagonian birds and wildlife photography, and information provided by citizen scientists and ornithologists, we confirmed the current Burrowing Owl's presence in Santa Cruz province. The species appears to be mostly localized to the city of Caleta Olivia and nearby open areas, Deseado Department, northeastern Santa Cruz province, within the Patagonian Steppe and, along the Atlantic coast, in the Mar Argentino ecoregions. Burrowing Owl breeds locally there, and individuals are seen yearlong. Although there are a few recent records of Burrowing Owl at other localities of Santa Cruz, we did not find evidence of a current broader distribution in this province, as most general bird guides and general ornithology books indicated in their distribution maps for the species. The southernmost known population of Burrowing Owls, restricted to northeastern Santa Cruz, provides a unique opportunity to monitor its progress. Furthermore, it could allow us to investigate the limiting factors and dynamics of its population in urban and natural areas of the Patagonian steppe and the Atlantic coast of Santa Cruz province.

**Key words:** Argentina, breeding, citizen science, distribution, Patagonia, population, status, *Strigiformes*

**RESUMEN.**— EVALUACIÓN DE LA PRESENCIA DE LA LECHUCITA DE LAS VIZCACHERAS (*ATHENE CUNICULARIA*) EN EL LÍMITE SUR CONTINENTAL DE SU DISTRIBUCIÓN EN LA PROVINCIA DE SANTA CRUZ, PATAGONIA, ARGENTINA. Históricamente, la distribución continental de la Lechucita de las Vizcacheras (*Athene cunicularia*) en la Argentina incluyó a la provincia de Santa Cruz. Sin embargo, durante casi un siglo, su presencia en la provincia estuvo basada en escasos, incluso erróneos, registros publicados, desconociéndose su estatus y distribución precisa. Confirmamos la presencia actual de esta especie en la provincia de Santa Cruz a través de diversas fuentes, incluyendo observaciones personales, encuestas, revisión crítica de bibliografía, búsqueda en bases de datos electrónicas (EcoRegistros y eBird), escrutinio de publicaciones en páginas y grupos de Facebook, enfocadas en aves argentinas y patagónicas, así como en fotografía de vida silvestre, y de información proporcionada por ciudadanos científicos y ornitólogos. Fue localizada mayormente en la ciudad de Caleta Olivia y sus áreas cercanas en el Departamento Deseado, noreste de Santa Cruz, en las ecorregiones de Estepa Patagónica y Mar Argentino; en este último caso, a lo largo de la costa atlántica. La especie nidifica en el área y se observan individuos durante todo el año. Si bien existen escasos registros recientes en otras áreas de Santa Cruz, no encontramos evidencias de una distribución actualizada más amplia en esta provincia, como lo indica la mayoría de los mapas de distribución en guías de aves y libros sobre ornitología general. La presencia de una población residente de Lechucita de las Vizcacheras en Santa Cruz, en el límite meridional de su distribución americana, provee una oportunidad única para su seguimiento, evaluar los factores que la limitan, y entender su dinámica poblacional en áreas urbanas y naturales de la estepa patagónica y la costa atlántica en esta provincia.

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There is very limited, and frequently outdated, information on the status, natural history, and distribution of Neotropical owls (Marks et al. 1999, Trejo et al. 2012, Rangel-Salazar and Enríquez 2015), even though this information is essential for evaluating population fluctuations, response to environmental changes, and threats (Rangel-Salazar and Enríquez 2015, Trejo and Bó 2015). Relatively better known

are Neotropical owls inhabiting open and semi-open lands, such as the Burrowing Owl (*Athene cunicularia*) (Trejo et al. 2012, Trejo and Bó 2015, Rangel-Salazar and Enríquez 2015), a widely distributed species from southern Canada and the United States of America to southern Argentina and Chile (Marks et al. 1999, Poulin et al. 2020). In Argentina, the Burrowing Owl is found in the southern, central, and northern prov-

inces, and it is considered a species of “least concern” (Trejo and Bó 2015, MAYDS and AA 2017). Currently, detailed information about its regional status is limited. In those areas where it has been recently studied, such as agroecosystems in the Pampas of central Argentina, the Burrowing Owl seems to be thriving (Sánchez et al. 2008, Pairo et al. 2017, Rebolo-Ifrán et al. 2017). The species has also successfully colonized several urban areas, benefitting from artificial night lighting, habituation to human’s presence, increased foraging efficiency, and availability of nesting substrates and prey (Sánchez et al. 2008, Cavalli et al. 2014, 2018, Rebolo-Ifrán et al. 2017; Baladrón et al. 2020, Rodríguez et al. 2021). In contrast, some populations in Canada and in the United States are declining and considered threatened due to habitat loss and fragmentation, and lack of burrows (Holroyd et al. 2001, Conway 2018, Poulin et al. 2020). A matter of concern is the fact that, by the 1920s, the Burrowing Owl was extirpated from Tierra del Fuego island in the southernmost province of Argentina, possibly due to sheep ranching practices; this population never recovered, and it is now considered extinct (Reynolds 1935, Iriarte et al. 2019). Thus, collecting baseline information about the presence of this species in its southernmost continental range of distribution may contribute to better understanding regional variations in its ecology and conservation status (Sexton et al. 2009). This is particularly important in Santa Cruz province, southern continental Patagonia, where anthropogenic activities such as the use of baits with strychnine and carbofuran for predator control, direct persecution, hold-leg traps, mining, and oil extraction are known to negatively affect several species of raptors (Olrog 1979a, De Lucca and Saggese 1989, Travaini et al. 2000, García Brea et al. 2010).

Historically, the Burrowing Owl was documented in Santa Cruz province by Scott and Sharpe (1915), based on observations made in the Río Chico Department during the late nineteenth century. Almost a hundred years after these initial observations, and without additional published records for this province, Navas and Bó (1997) reported that the Burrowing Owl was present in northeastern Santa Cruz, based on eleven skulls recovered from open petroleum pits, where these and many other birds died (Tubaró et al. 2000). Subsequently, Darrieu et al. (2008) included the species in their list of Santa Cruz province avifauna; however, other ornithological surveys of Santa Cruz province did not include the Burrowing Owl (Zapata 1967, Olrog 1979a, Chébez et al. 1988, De Lucca and Saggese 1992, Travaini et al. 2004, Im-

berti 2005, Roesler et al. 2014). Even in the absence of detailed records, and possibly due to these few existing early reports, several ornithological reference books have included most or the entire Santa Cruz province within the distribution range of this species (e.g., Olrog 1979b, 1984, Narosky and Yzurieta 1987, Fjeldså and Krabbe 1990, Canevari et al. 1991, Clark 1997, Mazar-Barnet and Pearman 2001, De la Peña 2019). Despite all listed above, the current distribution range, breeding areas and overall status of the Burrowing Owl in this province is unknown. Therefore, our goal was to investigate and determine the past and present status and distribution range of this owl in Santa Cruz province in southern continental Patagonia, Argentina. We also discuss potential factors that might influence its demography there. To the best of the author’s knowledge, this is the first analysis of Burrowing Owl’s population at the southern limit of its Pan-American distribution.

## STUDY AREA AND METHODS

### Study area

Santa Cruz province is in the southernmost continental end of Argentina, separated from Tierra del Fuego Island, insular Patagonia (Argentina and Chile) by the Strait of Magallanes. After Buenos Aires province, it is the second largest political geographic unit of this country, and the province with the lowest number of inhabitants/km<sup>2</sup>. Several major ecoregions and their respective ecotones can be found in Santa Cruz (Burkart et al 1999, Coronato et al. 2008). In the West, the orography is dominated by the Andes mountains, home of the Magallanes and Valdivian forest ecoregions. East of the Andes, mainland Santa Cruz is characterized by a succession of plateaus and lowlands where other major ecoregions are the Patagonian Steppe (central, east, and north) and the Patagonian grasslands (south). In the East, along the Atlantic coast, the Mar Argentino ecoregion covers its entire extent; cliffs of variable height and sand/pebbled beaches can be found there. For a detailed physical depiction of Santa Cruz phytogeography, hydrography, orography, and climate see Paruelo et al. (1998) and Coronato et al. (2008).

Human population in Santa Cruz province is scarce, mostly concentrated in a few cities and towns, with an average population density of 1.1 inhabitants/km<sup>2</sup> (INDEC 2012). Approximately 50% of Santa Cruz human population is found in a few coastal cities such

as Río Gallegos and Caleta Olivia, with more than 50 000 inhabitants each. Most towns have less than 10 000-20 000 inhabitants. Private ranches dominate the area, and the landscape has been strongly modified by a hundred-year long tradition of sheep ranching, which was considered as one of the most important economic activities in the province. In addition, mining, gas, and petroleum extractions are other important components of Santa Cruz economy. Fishing, timber industry, and tourism are additional economic activities, although more seasonal in character. Only 8% of Santa Cruz province is legally protected as national and provincial parks, mainly localized in the west and along the Atlantic coast; the remainder of the land is privately owned (Di Giacomo 2007).

### Burrowing Owl records and analysis

To understand the distribution and the status of Burrowing Owl in Santa Cruz we combined a series of approaches to collect data on the species. First, we conducted a detailed literature review to identify previously published and historical records of the species in Santa Cruz province. When possible, we contacted the authors to ask them for additional information and to corroborate some of the information thereby indicated. We also searched for other Burrowing Owl records in online databases (EcoRegistros and eBird). We also searched for photos and comments about this species in Argentinian Facebook pages and groups where raptors, including Burrowing Owl, were commonly featured. The authors of these records, photos and posts were also contacted, when possible, to obtain additional information (see below). We also contacted wildlife photographers, park rangers, ornithologists and birdwatchers who have visited Santa Cruz in the last two decades or are residents there. We concluded our search for records on this species on July 31, 2020. Additionally, we included data gathered during a recent ornithological trip in Santa Cruz (January 2020, R. Montero).

Overall, for each record we aimed to obtain information on date, location (locality and department), georeferences, number and age (adults or juveniles), presence of burrows, and evidence of reproduction (observation of eggs, nestlings and/or fledglings/juveniles) when available. For all collected records we identified the main ecoregion of Santa Cruz province where observations were made following Burkart et al. (1999) and Coronato et al. (2008). Reports of Burrowing Owls observed in areas inside or in the immediate periphery of houses and other buildings within

city limits were classified as urban. We considered the southern seasons as follows: summer (21 December–March 20); fall (21 March–20 June); winter (21 June–20 September); and spring (21 September–20 December). To avoid duplicating and overestimating the number of records, Burrowing Owls observed in several successive days (< 3 weeks) and in the same location ca. 500 m radius from its first observation and in the same year were considered as a single report. Burrowing Owls were considered resident when seen repeatedly during the year and in different seasons. Local citizens and other contributors were kindly asked to contribute with photographs of the species, when available, as indisputable evidence of their observations.

### RESULTS

The analyses of previously published records of Burrowing Owls allowed us to identify all historical reports on the species and to discover and to correct erroneous reports for Santa Cruz province (Table 1).

We obtained a total of 32 new, unpublished records of Burrowing Owls in Santa Cruz province, 18 of them were supported by photographic evidence in the period Sep 2012-Jul 2020 (Table 2). We did not identify through our search any other unpublished observations on the species before this period. Subsequent follow up and communication with contributors allowed us to obtain additional information for 19 records, including those supported by evidence (Table 2). These records of Burrowing Owls were collected in the province of Santa Cruz from a thorough assessment of website databases: 11 on Facebook, four on EcoRegistros and 17 on eBird.

Burrowing Owls were observed in urban and non-urban open land areas in or nearby Caleta Olivia city, respectively (Table 2, Figs. 1a and 1b), Patagonian Steppe ecoregion. Burrowing Owls were observed perching on or standing nearby houses, sides of urban lagoons, wire fence posts, yards, piles of earth, and roadsides and highways. Burrowing Owls were also observed along the Atlantic coast, Mar Argentino ecoregion, in non-populated areas north of the Caleta Olivia city, such as in the areas called La Lobería and Playa Acina (Table 2, Fig. 1c). Burrowing Owls were observed in seven opportunities on the coastal sand dunes and on the beach alongside the strips of land (approximately 100 m wide) between the National Highway 3 (RN3) and the sea (Table 2).

**Table 1.** Published records of Burrowing Owl in Santa Cruz. Those that were validated, accepted or confirmed are indicated with an asterisk (\*)

| Locality  | Reference                               | Comments   |
|---|---|--|
| Río Chico Department  | Scott and Sharpe (1915)*                | Record from 1898, one adult female and one adult male collected by AE Colburn.   |
| Cañadón Seco, Canadón León, El Cordón, and Piedra Clavada, Deseado Department | Navas and Bó (1997)*                    | These records are based on eleven skulls found at several oil pits in these localities of northeastern Santa Cruz, Deseado Department, in March and May 1994. These authors attributed these skulls to this species, preliminarily identified by A. Di Giacomo (Navas and Bó (1997), A. Di Giacomo pers. comm.). |
| Cabo Vírgenes, Güer Aike Department.  |   |  |
| Estancia La Angostura, Río Chico Department.                                  | Imberti <i>in</i> Darrieu et al. (2008) | Publisher error in Darrieu et al. (2008) (Imberti, pers. comm.).   |
| Ría of Gallegos river, Güer Aike Department                                   |   |  |
| Pinturas river, Lago Buenos Aires Department                                  | Imberti <i>in</i> Darrieu et al. (2008) | Publisher error in Darrieu et al. (2008) (Imberti, pers. comm.). This observation corresponds to Cueva de las Manos, Lago Buenos Aires Department, March 24, 1995 (Imberti pers. comm.).*  |
| Parque Nacional Bosques Petrificados de Jaramillo (PNBP), Deseado Department  | Imberti <i>in</i> Darrieu et al. (2008) | Based on a PNPB bird list, no specific location or date provided (Administración de Parques Nacionales 2018).  |



**Figure 1.** Photographic evidence of Burrowing Owl in Santa Cruz province, southern continental Patagonia, Argentina. a) Burrowing Owls within an urban setting of Caleta Olivia city, May 30 2020, photo by S. Herrera; b) Juveniles at their burrow entrance, Caleta Olivia city, Nov 28 2018, photo by M. Barrientos Vidal c) Perching on a sand dune by the Atlantic coast shore, Playa Acina, 23 Jan 2020, photo by R. Montero d) Only record of the species for southwestern Santa Cruz, Río Bote, 11 Oct 2017, photo by R. Taggiasco.

**Table 2.** Records of Burrowing Owl in Santa Cruz province, 2012–2020. Georeferences included only when available. Those with photographic evidence available are indicated with an asterisk (\*)

| Date            | Location  | Number and age <sup>a</sup> | Habitat  | Resident | Breeding | Reference                              |
|-----------------|---|-----------------------------|--|----------|----------|--|
| Sep 29–30, 2012 | <i>Ca.</i> Cemetery, Caleta Olivia,<br>46°27'35"S<br>67°31'48"W | 1                           | Urban  | Yes      | Yes      | Mariela Barrientos Vidal, pers. comm.* |
| Oct 21–23, 2012 | <i>Ca.</i> Cemetery, Caleta Olivia,<br>46°27'35"S<br>67°31'48"W | 1                           | Urban  | Yes      | Yes      | Mariela Barrientos Vidal, pers. comm.* |
| Feb 13, 2014    | Barrio Costa del Sol, Caleta Olivia                             | NA                          | Urban  | Yes      | NA       | Baltuska (2014)                        |
| Nov 24, 2014    | Barrio Costa del Sol, Caleta Olivia                             | 1                           | Urban  | Yes      | NA       | Roesler (2014)                         |
| Nov 24, 2014    | <i>Ca.</i> Cemetery, Caleta Olivia,<br>46°27'35"S<br>67°31'48"W | 1                           | Urban  | Yes      | Yes      | Mariela Barrientos Vidal, pers. comm.* |
| Aug 12, 2015    | Rotary 23, Caleta Olivia,<br>46°26'40.4"S<br>67°32'41.8"W       | 1                           | Urban  | Yes      | NA       | Silvia Herrera, pers. comm.*           |
| Jan 7, 2016     | La Lobería, RN3<br>46°06'54"S<br>67°37'42"W                     | 1                           | Atlantic coast (side of RN3)                         | NA       | NA       | Rost (2016)                            |
| Oct 11, 2017    | Río Bote, <i>ca.</i> Calafate                                   | 1                           | Pata-gonian steppe, abandoned small human settlement | NA       | NA       | Rubén Taggiasco, pers. comm.*          |
| Mar 23, 2018    | RP12, south of Caleta Olivia                                    | 1                           | Urban  | NA       | NA       | Olejnuk (2016)                         |
| Mar 25, 2018    | RN3, Caleta Olivia  | 2                           | Urban (side of RN3)                                  | NA       | NA       | Llanos (2018)*                         |
| Jul 8, 2018     | RN3, south of Caleta Olivia                                     | 3                           | Urban (side of RN3)                                  | NA       | NA       | Mariela Barrientos Vidal, pers. comm.* |
| Nov 28, 2018    | <i>Ca.</i> Cemetery, Caleta Olivia                              | 3 Juveniles                 | Urban  | Yes      | Yes      | Mariela Barrientos Vidal, pers. comm.* |
| Dec 16, 2018    | <i>Ca.</i> JCT RN3 and RP12, Caleta Olivia                      | 1                           | Urban  | NA       | NA       | Martin and Roesler (2018a,b)           |
| Dec 17, 2018    | Barrio Costa del Sol, Caleta Olivia                             | 1                           | Urban  | Yes      | NA       | Martin and Roesler (2018c,d)           |

|                |  |                                     |                              |     |     |   |
|----------------|--|-------------------------------------|------------------------------|-----|-----|---|
| Jul 17, 2019   | RN3, south of Caleta Olivia  | 6                                   | Atlantic coast (side of RN3) | NA  | NA  | Brea and Sosa (2019a,b)*                        |
| Aug 12, 2019   | RN3, south of Caleta Olivia  | 7                                   | Atlantic coast               | NA  | NA  | Sosa (2019)*                                    |
| Oct 15, 2019   | RN3, south of Caleta Olivia  | 1                                   | Atlantic coast               | NA  | NA  | Morgenthaler (2019)                             |
| Oct 21, 2019   | Caleta Olivia  | 2                                   | Urban/<br>Atlantic coast     | NA  | NA  | García Loyola (2019)                            |
| Dec 1, 2019    | RP12, Cañadón Seco   | 2                                   | Urban                        | NA  | NA  | Klavins (2019a)                                 |
| Dec 1–2, 2019  | Barrio Costa del Sol, Caleta Olivia  | 2                                   | Urban                        | Yes | NA  | Klavins (2019b)                                 |
| Dec 2, 2019    | Caleta Olivia  | 1                                   | Urban/<br>Atlantic coast     | NA  | NA  | Álvarez (2019)                                  |
| Dec 14, 2019   | Racetrack, Río Gallegos<br>51°39'18.3"S<br>69°14'31.6"W  | 1                                   | Urban                        | NA  | NA  | Pedro Aguila, pers. comm.*                      |
| Dec 29, 2019   | RN3, south of Caleta Olivia<br>46°29'05.3"S<br>67°29'08.2"W  | 1                                   | Atlantic coast               | Yes | NA  | Tiberi (2019)*                                  |
| Jan 22, 2020   | RN3, south of Caleta Olivia  | 2                                   | Urban                        | NA  | NA  | Montero (2020a)                                 |
| Jan 23, 2020   | Playa Acina,<br>46°03'12"S<br>67°37'37"W   | 1                                   | Atlantic coast               | NA  | NA  | Montero (2020b)*                                |
| Feb 7–10, 2020 | Barrio Costa del Sol, Caleta Olivia  | 2                                   | Urban                        | Yes | NA  | Klavins (2020)                                  |
| Mar 1, 2020    | Reserva Natural Provincial y Municipal "Humedal Caleta Olivia", Caleta Olivia<br>46°27'7"S<br>67°32'37"W | 2, including one juvenile           | Urban                        | Yes | Yes | Mariela Barrientos Vidal, pers. comm.*          |
| Apr 28, 2020   | Cañadón Seco<br>46°33'21.0"S<br>67°37'12.4"W   | 6 (including juveniles)             | Pata-gonian steppe           | Yes | Yes | Ávalos and Carranza (2020)*                     |
| May 5–11, 2020 | Cañadón Seco   | 2–4                                 | Pata-gonian steppe           | Yes | Yes | Miguel Ávalos and Eduardo Carranza pers. comm.* |
| May 30, 2020   | Rotary 23, Caleta Olivia<br>46°26'40.4"S<br>67°32'41.8"W   | 3, including one juvenile           | Urban                        | NA  | Yes | Silvia Herrera, pers. comm.*                    |
| June 2, 2020   | Cañadón Seco   | 4 (one group) and 3 (another group) | Pata-gonian steppe           | NA  | NA  | Miguel Ávalos and Eduardo Carranza pers. comm.* |
| July 7, 2020   | Cañadón Seco<br>46°33'23.9"S<br>67°37'37.6"W   | 3 juveniles                         | Urban                        | Yes | Yes | Miguel Ávalos and Eduardo Carranza, pers. comm. |

\*All adults, except when noted

Only 2 records do not belong to northeastern Santa Cruz province, in or nearby areas of Caleta Olivia city, Deseado Department. One of these records comes from Río Bote, near the city of Calafate, Lago Argentino Department, southwestern Santa Cruz. One Burrowing Owl was observed there and photographed in October 2017 (Table 2, Fig. 1d). The other record would be the southernmost of the species in Santa Cruz and consists of one individual observed in Río Gallegos city, December 14, 2019 (Table 2).

Burrowing Owls were recorded yearlong and during all the months; the highest number of records (for all years combined) was in spring ( $n = 14$ ), followed by summer ( $n = 7$ ), fall ( $n = 6$ ), and winter ( $n = 5$ ). Records almost doubled in numbers during the period of spring–summer when compared with the number of records during the period fall–winter. Moreover, citizen scientists, birdwatchers, and ornithologists that we consulted consider the species to be a year-long resident (Table 2).

Most observations reported Burrowing Owls as being seen alone or in pairs, less commonly they were observed in small groups of 3–4 or more individuals (Table 2), mainly adults. Fledglings and juveniles were observed in the months of November (Fig. 1b), March, April, May, and July at different locations. Most reports also indicated the presence of nearby active burrows, in some cases used for many years (M. Barrientos Vidal, pers. comm.) (Fig. 1a).

## DISCUSSION

Although the Burrowing Owl was included in the Santa Cruz province by many previously published ornithological reference books and field guides (see introduction for a selected list), we established that most historical reports for this province were inexact or erroneous, except for a few (Table 1). The alleged presence of this species in the Parque Nacional Bosques Petrificados de Jaramillo (APN 2018; see Table 1) needs confirmation, as it has not been reported there by several ornithological surveys (Chébez et al. 1988, De Lucca and Saggese 1992, Imberti pers. comm., Saggese et al. unpublished data).

Validated records during the period 2012–2020 (Table 2) are the only ones that support the current inclusion of Burrowing Owls in Santa Cruz province, but only for a few locations. We recommend caution when considering the number of records presented

here; they should not be taken as absolute indicators of the numbers/abundance of Burrowing Owls present in this province. Instead, they provide repeated evidence of their presence and their resident status for these years in or nearby the city of Caleta Olivia (Deseado Department, northeastern Santa Cruz). Some records, although separated by several weeks, at the same location (ca. Caleta Olivia's cemetery and Barrio Costa del Sol, and Cañadón Seco) probably represent the same individuals or populations residing there (Table 2). Nevertheless, these records indicate that the species seems to be thriving in areas within or around the city of Caleta Olivia.

The only previously published and validated reference for areas outside northeastern Santa Cruz was the observation made over a hundred years ago by Scott and Sharpe (1915) of two birds (collected) in Río Chico Department (Table 1). Whether the observations made at the settlement named Río Bote, near Calafate city (southwestern Santa Cruz) in 2017, and in Río Gallegos city, southeastern Santa Cruz in 2019 represent unique findings or whether they indicate additional population nucleus developing there needs to be further determined. Furthermore, raptor surveys (although not specific for Burrowing Owls) in several areas of this province between 2008 and 2011 (Saggese M, Ellis D, Quaglia AI, and Nelson RW, unpublished data, see Saggese et al. 2020 for routes and transects covered) and more than 10 years of bird watching in southern Santa Cruz (Amorós C and Amorós M, pers. comm.) did not register this species.

The reasons why the Burrowing Owl appears to have such a limited distribution in Santa Cruz province are not known. Food and nesting sites and nest substrates are important limiting factors for raptors worldwide (Newton 1979). The Patagonian Steppe ecoregion of Santa Cruz is considered as of low wildlife diversity when compared with the Monte ecoregion of central and northern Patagonia (Cueto et al. 2008, Pardiñas et al. 2011, Lessa et al. 2012, Britman et al. 2014, Roesler et al. 2014, Minoli et al. 2015), where Burrowing Owls are more commonly found. Therefore, it is possible that low prey richness and availability and/or its abundance may be limiting the geographical spread of this species.

Burrows are also a critical limiting resource for this species as nesting sites; some Burrowing Owl populations rely on burrows dug by other animals while other populations are known to dig their own (Conway 2018). In central Argentina, Burrowing Owls

dig their own burrows, but they can also use those made by mammals and reptiles, and even use human-made structures (Hudson 1920, Bellocq 1987, 1993, Machicote et al. 2004, Borsellino 2017, Baladrón et al. 2020). Whether in southern continental Patagonia the species do the same or they depend on burrows dug by local wildlife is unknown. The diversity of digging mammals is much lower in the Patagonian Steppe than in the Monte or Pampas ecoregions, and soil type can also influence Burrowing Owls' home-range selection (Stevensen et al. 2011). Oil digging machinery and bulldozers loosens densely compacted soil in some areas around Caleta Olivia which could be facilitating Burrowing Owl's use of these areas (L. M. Sosa, pers. comm.).

Predators may also be limiting the presence of Burrowing Owls in Santa Cruz. Low richness and abundance of predators in urban areas may explain changes in the habitat selection pattern of Burrowing Owls toward them (Rebolo-Ifrán et al. 2017). The fact that most of our records come from the city of Caleta Olivia and its surrounding areas suggests that predation could limit their expansion in Santa Cruz. Several species of diurnal and nocturnal raptors prey upon Burrowing Owl, sometimes even decimating local populations (Poulin et al. 2020). Recent observations of a Harris Hawk (*Parabuteo unicinctus*), a recently arrived raptor in Cañadón Seco, preying upon Burrowing Owls (M. Avalos, pers. comm.), suggests that predators could have a limiting role in the establishment of early nucleus populations.

The extinction of this species in Tierra del Fuego is allegedly caused by sheep ranching practices (Reynolds 1935, Iriarte et al. 2019). In other areas of Argentina, Burrowing Owls seem to coexist with agricultural practices, including cattle ranching (Di Giacomo 2005, de Tommaso et al. 2009, Sagge MD pers. obs). However, the real impact of current sheep ranching practices on this species in southern Patagonia is unknown.

Some Burrowing Owl's populations can exploit human-made habitats, sometimes with a preference for urban habitat over natural grasslands and low-intensity agropastoral lands (Conway et al. 2006, Baladrón et al. 2016, Borsellino 2017, Martínez et al. 2017, Rebolo-Ifrán et al. 2017). Burrowing Owls appear to be using both urban and natural habitats in Caleta Olivia and its surroundings. This city, near the Atlantic coast, is one of the largest and most rapidly growing cities in southern continental Patagonia,

with an estimated population of 52 612 inhabitants by 2010 (INDEC 2012). Burrowing Owls can use urbanized landscapes along the Atlantic coast in central Argentina (Baladrón et al. 2016, Martínez et al. 2017), without being adversely impacted when nesting in areas with moderate levels of urban development (Baladrón et al. 2020). While this association with urban habitats can result in positive outcomes for raptors, urban areas can also potentially act as an ecological trap (Isaac et al. 2014, Franco and Marçal-Júnior 2018, Mannan and Steidl 2018).

Climate may be another limiting factor for this species at these southern latitudes. Winters may be too cold to support a population in central and southern Santa Cruz province. However, the species used to be present in Tierra del Fuego, at much southern latitudes (Reynolds 1935, Iriarte et al. 2019), suggesting that low temperatures were not restrictive for the species. At least, it seems possible that climate may determine winter presence in Caleta Olivia and surrounding areas, as the number of records appear to decrease in winter (Table 1). This can either be result of a decrease in the number of observers and time dedicated to birdwatching due to harsh weather conditions or be a consequence of Burrowing Owl population dispersal and/or migration to more favorable latitudes (Holroyd et al. 2010, Poulin et al. 2020). However, studies conducted in the Pampean ecoregion of Argentina, at milder latitudes, indicate that Burrowing Owls usually disperse only on short distances and breeding pairs show nest site fidelity along the years (Luna et al. 2019, 2020).

The presence of juveniles in the months of November, March, April, May, and July, and reports of pairs breeding locally confirms northeastern Santa Cruz as the southernmost latitude where this species breeds along its Pan-American distribution. The presence of juveniles in spring, summer and winter may indicate the presence of family units due to delayed dispersal of some individuals, as reported in the Pampean ecoregion for both urban and rural populations (Luna et al. 2021). This can indicate either a very prolonged breeding season or that double brooding may occur in this area, as reported elsewhere (Gervais and Rosenberg 1999, Borsellino 2017, Poulin et al. 2020).

Current threats to the species in Santa Cruz are unknown. In the past, open petroleum pits were a serious threat to many Patagonian birds (Tubaro et al. 2000), including Burrowing Owls (Navas and Bó

1997). Collision with vehicles, predation by feral dogs, use of anticoagulant rodenticides, land disturbance, habitat loss and targeted persecution due to superstition are common threats to this species along its extensive range of distribution (Trejo and Bó 2015, Cavalli et al. 2016, Franco & Marçal-Junior 2018, Paulin et al. 2020).

The collaboration between ornithologists, wildlife photographers, and citizen scientists combined with information gathered from social media platforms has provided an important benefit to our understanding of the natural history, ecology, and conservation of avian species, including Burrowing Owls and other raptors (Cavalli et al. 2014, Saggese et al. 2014). As a result of this study, we have expanded the current known range of the species at the southernmost limit of its distribution, confirmed its breeding and year-long resident status, and the colonization of an urban area in the Patagonian Steppe and coastal sand dunes in the Mar Argentino ecoregion.

Results of this study do not mean that we know in detail the overall distribution of Burrowing Owls in Santa Cruz, a province that covers a surface of 4459 km<sup>2</sup> and has one of the lowest human population sizes, mostly restricted to a few cities and towns. We can assume that most sightings of Burrowing Owls reported here belong to areas of higher human development, such as some cities and surrounding areas, whereas vast areas of the province may be neglected. Citizen science is a useful tool in ornithological studies but it also offers some potential challenges, such as spatial bias and variation in effort (Johnston et al. 2021). This can be solved by future geographically extensive and focused Burrowing Owl surveys that follow specific methodologies recommended for the study of this species (Conway and Johnson 2003).

The southernmost known population of Burrowing Owl in the world provides a unique opportunity to monitor the progress of its nucleus, not only in the city of Caleta Olivia but also in the rest of Santa Cruz province. Furthermore, this population could represent a suitable model to understand several aspects of their ecology at the southern limit of its distribution including: (a) How breeding phenology and ecology compares to northern populations? (b) What are the advantages and disadvantages of Burrowing Owl's association with the city of Caleta Olivia? (c) How the factors that contribute to Burrowing Owl's urban colonization in other ecoregions support their presence in this city and in the Patagonian Steppe? (d) What is

the pattern of juvenile dispersal? (e) Are Burrowing Owls migratory at these latitudes? (f) What factors are limiting its distribution in Santa Cruz, and (g) Are there potential threats for the successful stability of the species in this province? Further research in the following years will help us to answer these and other questions regarding the presence of Burrowing Owl in Santa Cruz province.

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