

NESTING SEABIRDS ON THE KAIKUÉ-LAGARTIJA ISLAND NATURE SANCTUARY, CALBUCO ARCHIPELAGO, SOUTHERN CHILE

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ABSTRACT

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Kaikué-Lagartija Island, one of the few sites in the Calbuco Archipelago (southern Chile) that is still in its natural state, has been declared a Nature Sanctuary. However, little has been published regarding the island's natural history. Here we describe the assemblage of nesting seabirds on Kaikué-Lagartija Island, including estimates of abundance, during the breeding seasons of 2012/13, 2014/15, and 2015/16 for eight species found nesting. The Magellanic Penguin *Spheniscus magellanicus* is the most abundant seabird on this island, with a breeding population of around 200 pairs. The number of nesting pairs of Kelp Gull *Larus dominicanus* increased from 17 to 23 active nests during the study. Only one pair of Red-legged Cormorant *Phalacrocorax gaimardi* and five pairs of Rock Shag *Phalacrocorax magellanicus* nested on the island. In the 2012/13 season, five pairs of the Imperial Shag *Leucocarbo atriceps* nested, but the area was subsequently colonized by roosting Peruvian Pelicans *Pelecanus thagus*. Also observed were Fuegian Steamer Ducks *Tachyeres pteneres*, Dark-bellied Cinclodes *Cinclodes patagonicus*, and Snowy Egrets *Egretta thula*. Clearly, the Kaikué-Lagartija Island Nature Sanctuary, though small, is of high value for the conservation of seabirds endemic to Patagonia. Future lines of research for the conservation of nesting seabirds on the island were identified.

Key words: Kaikué-Lagartija Island, nesting seabirds, Patagonia, seabird conservation

INTRODUCTION

Seabirds typically nest in colonies that are located in hard-to-reach coastal locations such as islands and islets (Schlatter & Simeone 1999, Coulson 2001). Seabird colonies are highly visible, making them ideal tourist attractions. However, human disturbance to the colonies negatively affects bird physiology, reproductive behavior, reproductive success, and population trends (Carney & Sydeman 1999, Ellenberg *et al.* 2006).

The Calbuco Archipelago is located between Reloncaví Sound and the Gulf of Ancud, in the inner sea of the Región de Los Lagos, southern Chile. Within this archipelago, Kaikué-Lagartija Island stands out, declared in 2017 as a Nature Sanctuary and protected by the Republic of Chile, in coordination with the Municipality of Calbuco (MMA 2017). This island is one of the few sites in the area on which conservation efforts have maintained a natural condition (MMA 2017). Over time, this island has been visited by canoeists and by Veliche and Chono gatherers who wander the coast

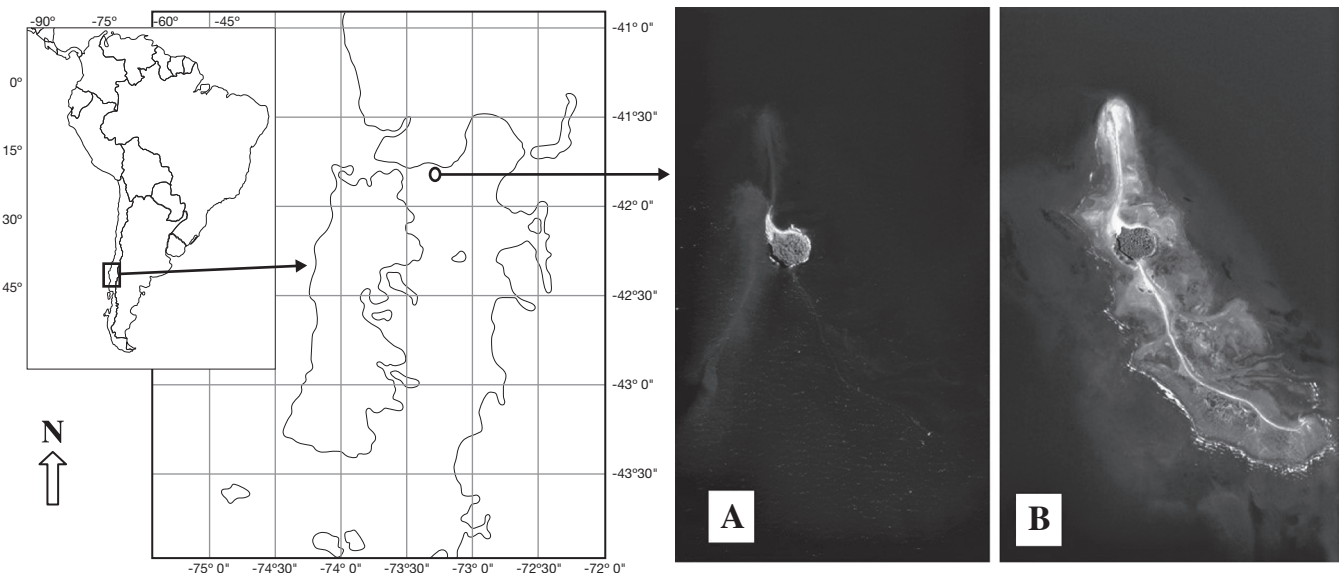


Fig. 1 Geographic location of Kaikué-Lagartija Island, in the Calbuco Archipelago, Región de Los Lagos, southern Chile. The changes in surface area due to the tidal cycle are shown at high tide (A) vs. low tide (B).

(Mansilla 2005). It was also visited by prominent naturalists such as Claudio Gay in 1836, Robert Fitz-Roy in 1848, and more recently, by Gerry Clark in 1983 (Mansilla 2005, Clark 2008). However, much remains unknown about the natural history of this island. Its new status as a Nature Sanctuary requires that basic biological information be acquired for effective management (Woodley *et al.* 2019). Therefore, we surveyed the island and herein describe for the first time its assemblage of nesting seabirds, including estimates of breeding pairs.

METHODS

Study site

Kaikué-Lagartija Island (GPS coordinates: 41°48'39"S, 073°17'13"W) is located between Abtao Island and Quihua Island in the Calbuco Archipelago, close to the Chacao Channel in the inner sea of Región de Los Lagos, southern Chile (Fig. 1). This uninhabited island is dominated by a hill that covers a surface area of 0.75 ha (0.0075 km²), reaching an altitude of 16 m above sea level (masl; MMA 2017). The hill is densely covered by blackberry *Rubus ulmifolius* and quila *Chusquea quila*, along with *Luma apiculata*, *Aristotelia chilensis*, *Fuchsia magellanica*, and *Sophora cassioides*. The hill is low in the north, inclines toward the south, and ends in a rocky wall that rises 14 masl and is battered by waves and winds, with resulting landslides. The hill makes up the entire island at high tide; the smooth, gradual slope of the intertidal area results in an expansion of the total surface area to 30 ha (0.30 km²) during low tide (Fig. 1).

In the extensive intertidal habitat, mainly on the south side, people gather algae (*Gigartina skottsbergii*, *Gracilaria chilensis*) and shellfish (*Venus antiqua*, *Gari solida*). The name of the island is from the word Kaikué (Chono for "island of the birds") and Lagartija (Spanish for "lizard", because it has a lizard shape during low tide; Fig. 1).

Surveys

Observations were carried out during the breeding seasons of 2012/13, 2014/15, and 2015/16. During the 2012/13 season, visits

occurred on 13 October, 13 November, and 27 November 2012, and on 16 January 2013. During the 2014/15 season, visits occurred on 27 August, 30 September, 28 October, 25 November, and 30 December 2014, and on 20 January and 01 April 2015. During the 2015/16 season, visits occurred on 26 October, 15 November, and 15 December 2015.

The populations of nesting seabirds were evaluated by direct counts of occupied nests, i.e., those with the capacity to hold eggs and that were occupied by at least one bird (Bibby *et al.* 2000). In the case of the Magellanic Penguin *Spheniscus magellanicus*, caves that exhibited signs of occupation, such as the accumulation of down and feces in the entrance, were considered active (Delgado *et al.* 2019).

During each visit to the island, three researchers conducted two main activities: i) counting nests on the hill's surface and ii) searching caves on the hill for Magellanic Penguin nests. A survey of the entire island, consisting of one transect that was 0.34 km long and 0.05 km wide, started on the sandbar at the northernmost tip of the island (west side), and headed east. Likewise, we climbed the hill to estimate the number of Magellanic Penguin nests at five monitoring points that were distributed in different types of vegetation (see Table 1 for details).

Information was analyzed for the relative abundance of active nests of each species in different breeding seasons. An exception was the Magellanic Penguin, for which we approximated the proportion of active nests in the area covered by the five fixed monitoring points. We also calculated the percentage of Magellanic Penguin nests occupied, considering the number of active and inactive nests at each fixed monitoring point.

RESULTS

On Kaikué-Lagartija Island, the nesting of the following species was registered: Magellanic Penguin, Kelp Gull *Larus dominicanus*, Rock Shag *Phalacrocorax magellanicus*, Imperial Shag *Leucocarbo atriceps*, Red-legged Cormorant *Phalacrocorax gaimardi*, Fuegian Steamer Duck *Tachyeres pteneres*, Dark-bellied Cinclodes *Cinclodes patagonicus*, and Snowy Egret *Egretta thula*.

TABLE 1

Details of our fixed monitoring points for the Magellanic Penguin *Spheniscus magellanicus* population on Kaikué-Lagartija Island

Point ^a	Geographical coordinates	Radius (m)	No. of caves	Area (m ²)	Dominant vegetation ^b
1	41°48'38.9004"S, 073°17'15.9871"W	7	11	154	A
2	41°48'38.5944"S, 073°17'15.0854"W	5	11	79	A
3	41°48'39.4512"S, 073°17'15.9291"W	6	6	113	A,B,C,D,E
4	41°48'39.7248"S, 073°17'14.9252"W	9	14	254	C,D,E,F
5	41°48'40.6320"S, 073°17'16.9375"W	8	11	201	B,D,E,G

^a The radius and area covered by each point is indicated, as well as the number of caves present (used for nesting by the penguins).

^b A) *Rubus ulmifolius*, B) *Chusquea quila*, C) *Aristotelia chilensis*, D) *Luma apiculata*, E) *Fuchsia magellanica*, F) *Sophora cassioides*, G) *Greigia landbeckii*

Magellanic Penguins nested over much of the hill, in caves that were greater than one meter deep and covered by dense vegetation. This condition limited the count accuracy for eggs and chicks. Among the dense vegetation, the penguins used a network of paths to walk between the sea and their nests. Monitoring of penguin nests began in late August 2014, when active nests already existed (Table 2); occupation of nests was 43.4% but increased through November to a maximum 77.4% before decreasing to 47.2% in December (Table 2). At the end of September 2014, two eggs were observed in a shallow nest outside the monitoring points; these were not included in our analysis but provided an approximate laying time for this penguin population. Chicks were observed in November. By the end of December 2014, chicks were large enough to wander, and groups of chicks were observed among the vegetation in the company of some adults. This movement from nests may explain the decrease in active nests estimated in December 2014. In January 2015, groups of older chicks were found on the beach and some were swimming.

The estimated area of the Kaikué-Lagartija Island hill that was occupied by penguin nests was 4000 m², whereas the total area covered by our five monitoring points was 801 m², corresponding to 20% of the space used to nest. Assuming a homogeneous distribution of the nests and a maximum of 41 active nests (in November 2014) in the survey area, we estimate ~205 pairs of Magellanic Penguin for the entire island.

In October 2015, we resumed monitoring Magellanic Penguin nests at the same five points (Table 2). Nest occupation was 66.1%, increasing to 67.9% in November before decreasing to 64.2% in December (Table 2). Again, a homogeneous distribution of the nests was assumed. In 20% of the total surveyed nesting area, a maximum of 36 active nests was observed, leading to an overall estimate of 180 nesting pairs.

Kelp Gulls nested in various places around the Kaikué-Lagartija Island hill and at different elevations. Nests were built out of grass and algae on rocks and beach areas close to vegetation. During the 2012/13 and 2014/15 seasons, the gulls constructed nests in November and laid eggs. A total of 17 active nests were counted in the 2012/13 season, whereas in the 2014/15 season, we observed 23 active nests of which four were among the vegetation covering the hill, close to penguin nests; the rest were not among foliage. In both seasons, a median of 2.5 eggs per nest was estimated. In January, the chicks departed their nests, taking refuge in the nearby vegetation.

Rock Shags nested in the upper area of the rocky wall located at the southern edge of the Kaikué-Lagartija Island hill. During the 2012/13 season, three pairs of cormorants began nesting in mid-November, building nests in cavities in the rock wall. Two new pairs were observed in January 2013 nesting in the flat area at the top of the wall. During the 2014/15 season, four pairs of cormorants began to nest in September, at the top of the wall. In October 2014, the number of active nests decreased to three, then increased to six in November before decreasing to five in January. Finally, two nests with two eggs each were observed in January.

Imperial Shags nested in the flat area located at the top of the rocky wall at the southern edge of the Kaikué-Lagartija Island hill. In December 2012, four pairs of this species began to nest, increasing to five pairs during January 2013. However, during the 2014/15 season, Imperial Shags did not nest in this area, as it had become colonized by Peruvian Pelicans *Pelecanus thagus* as a roost (> 300 individuals).

One pair of Red-legged Cormorants built their nest in a cavity of the rocky wall at the southern edge of the hill in January 2013. This was our only observation of this species nesting on the island for the entire study. This pair used algae (*Gigartina skottsbergii*, *Gracilaria chilensis*) to construct their nest, and two chicks were hatched.

Fuegian Steamer Ducks nested in the dense bushy vegetation of the hill, specifically under a ravine located in the northern part of the island. Due to the difficult access, it was not possible to reach the nests, though adults were observed walking toward the sea. During both the 2012/13 and 2014/15 breeding seasons, two pairs of ducks were observed in the intertidal and subtidal areas. During January 2015, a pair was observed swimming with four chicks near the shore of the island.

In both the 2012/13 and 2014/15 seasons, Dark-bellied Cinclodes nested in small caves and existing cracks in the hill. The west edge of the contour is rocky and without vegetation. Thus, it was possible to observe the entry and exit of the cinclodes toward their nests. Six active nests were observed in both years. However, additional nests occurred around the contour of the hill, and a more detailed count is required to study the cinclodes population.

Finally, Snowy Egrets nested in the vegetation on the hill at the center of the island, building their nests on top of the dense quila

TABLE 2
Number of active (A) and inactive (I) Magellanic Penguin *magellanicus* nests at each monitoring point during different months of the 2014/15 and 2015/16 breeding seasons on Kaikué-Lagartija Island, Calbuco, Chile

Monitoring Point	2014/15										2015/16							
	Aug		Sep		Oct		Nov		Dec		Jan		Oct		Nov		Dec	
	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I
1	4	7	6	5	8	3	9	2	3	8	0	11	8	3	8	3	8	3
2	6	5	6	5	8	3	9	2	4	7	1	10	6	5	7	4	5	6
3	3	3	2	4	2	4	3	3	3	3	2	4	5	1	6	0	6	0
4	7	7	4	10	8	6	10	4	7	7	5	9	8	6	8	6	8	6
5	3	8	9	2	11	0	10	1	8	3	3	8	8	3	7	4	7	4
Total	23	30	27	26	37	16	41	12	25	28	11	42	35	18	36	17	34	19

foliage. During 2014, two nesting groups were observed, each consisting of more than 10 active nests; most had 2–3 eggs per nest.

DISCUSSION

Magellanic Penguins are the most abundant seabird nesting on Kaikué-Lagartija Island, with a breeding population of around 200 pairs. This species is endemic to Patagonia and is classified as Near Threatened (BirdLife International 2018a). Other Magellanic Penguin nesting sites that exist near Kaikué-Lagartija Island are Doña Sebastiana Island and the Puñihuil Islets Natural Monument, both located on the exposed coast of the Región de Los Lagos (Espinosa & von Meyer 1994, Simeone 2005). Only in the Puñihuil Islets Natural Monument are there estimates of the nesting population of this penguin, and it is close to 480 breeding pairs (Simeone 2005, Reyes-Arriagada *et al.* 2013). There are mixed colonies of Magellanic and Humboldt *Spheniscus humboldti* penguins at only three sites worldwide, and they all are located on the coastline of the Región de Los Lagos (Simeone & Schlatter 1998, Cursach *et al.* 2009, Simeone *et al.* 2009). Inside one of the caves on the hill of Kaikué-Lagartija Island, we found a dead Humboldt Penguin with a leg caught in a bindweed *Cissus striata* and with signs of having participated in a fight with another penguin. Another single Humboldt Penguin was observed on the island's beach, but to date, Humboldt Penguins have not been recorded nesting on Kaikué-Lagartija Island.

Regarding future lines of research for the conservation of the Magellanic Penguin in this protected area, it would be beneficial to investigate feeding areas, routes used, and metapopulation dynamics among other nesting sites. In the Puñihuil Islets Natural Monument, it was determined that a commonly used feeding area is located 600–800 km to the north, in the Gulf of Arauco (Skewgar *et al.* 2014, Pütz *et al.* 2016). However, there are also some individuals that remain closer to the island (Skewgar *et al.* 2014, Pütz *et al.* 2016). A female Magellanic Penguin has been recorded nesting in the Puñihuil Islets Natural Monument, and it visited Kaikué-Lagartija Island (~90 km away) during a feeding trip (Pütz *et al.* 2016).

The Kelp Gull is abundant and widely distributed in the Southern Hemisphere and is classified as Least Concern; its population has generally increased since the early 1990s (BirdLife International 2018b). Population growth is related to increased food availability from human activities, such as fishing waste and urban litter (Lisnizer *et al.* 2015, Yorio *et al.* 2016). On Kaikué-Lagartija Island, an increase in the number of nesting pairs of this species was observed. This could be a result of the intense of fishing and aquaculture development, as well as port and urban activities in the vicinity of Kaikué-Lagartija Island. The Kelp Gull is a predator of eggs and chicks of other seabirds (Yorio & Quintana 1997, Quintana & Yorio 1998), and on Kaikué-Lagartija Island, it nested near the Magellanic Penguin caves. Future research on Kaikué-Lagartija Island could examine behaviors and predation rates of the Kelp Gull on the nests of other seabirds, as well as their larger-scale foraging movements.

The arboreal and shrubby vegetation of Kaikué-Lagartija Island favors the nesting of the Fuegian Steamer Duck, as well as the Snowy Egret and some land birds such as the Austral Thrush *Turdus falcklandii* and House Wren *Troglodytes aedon*. However, during our visits to the island, we witnessed gradual deforestation, both

for firewood extraction and the construction of improvised awnings by algae gatherers. Vegetation cover is important to the breeding success of terrestrial and marine birds, including the Magellanic Penguin (Stokes & Boersma 1998, García-Borboroglu *et al.* 2002). For this reason, future research should involve the diversity of plants on the island, succession processes, ecological restoration, and their relationship with the breeding success of nesting birds.

The Kaikué-Lagartija Island Nature Sanctuary is a small island with high value for the conservation of seabirds endemic to Patagonia. Its new status as a wild protected area is expected to facilitate the management of threats that affect nesting seabirds in the area. The main *a priori* threats we observed included the illegal harvesting of trees, unauthorized access by tourists (visitors are regulated because of the island's protected status), water quality degradation from the activities of a nearby commercial port, and the development of industrial aquaculture and artisanal fishing near the island. Another concern is the abundance of plastics in the sea—on 13 November 2012, a Magellanic Penguin was found with a plastic ring from a motor oil bottle stuck around its beak and head.

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