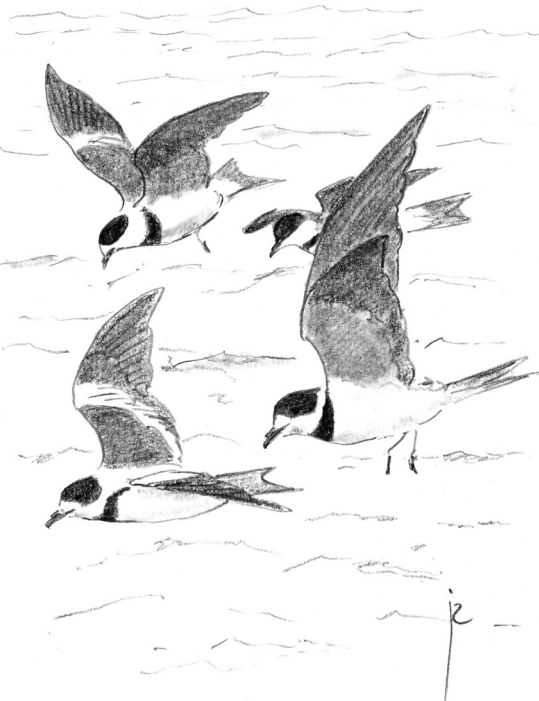


First breeding site record of Hornby's Storm Petrel *Oceanodroma hornbyi* in the Atacama Desert, Chile

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Hornby's Storm Petrel *Oceanodroma hornbyi* is endemic to the Humboldt Current Region. Historically, little has been known about the location of the species' breeding sites or the size of its population. For these reasons, this species has been classified as 'Data Deficient' by IUCN, and it is difficult to know whether the species is threatened, and if so, what conservation actions may be necessary. As part of the project 'Golondrinas del Desierto' a search for the colonies of this species began in November 2013. It was known that the species breeds in the Atacama Desert, because some mummified individuals had been found there, and fledglings attracted by lights whilst on their way to the sea were found in nearby coastal cities. In this paper, we describe the first breeding site discovered for this species. This breeding location is 75 km from the shoreline, at 1100 meters above sea level, in the centre of the Atacama Desert, also known as the 'absolute desert'. However, there is strong anthropogenic pressure on this desert due to the development of mines and solar energy projects. To protect these birds, it is important to estimate the breeding population size of the colony, search for new colonies and assess the threats to each of them, and to evaluate how many fledglings are drawn off course by lights into cities and industrial sites and how many die there.

Key words: Hornby's Storm Petrel, Ringed Storm Petrel, data deficient, seabird, petrel

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Hornby's Storm Petrel *Oceanodroma hornbyi* is an endemic species of the Humboldt Current Region, regularly observed at distances between 30 and 500 km off the southern coasts of Ecuador, Peru and northern Chile (Murphy 1936, Spear & Ainley 2007). During the southern spring, the species is concentrated off the southern coast of Ecuador and northern Peru, and in the autumn off the southern coast of Peru and northern Chile (Spear & Ainley 2007).

The population has been estimated at between 1000 and 90,000 individuals (Brooke 2004, Birdlife International 2016). However, Spear & Ainley (2007) calculated the abundance of this species through transects on open sea, estimating populations of 637,200

individuals in the southern spring and 1,011,900 individuals in autumn. This uncertainty as to their population size could be solved by locating their breeding colonies and estimating their sizes (Carboneras & Bonan 2017), although that estimation would not include the non-breeding population. In any case, locating the colonies is an important step to assess the vulnerability of the species and to protect it if necessary.

Hornby's Storm Petrel is one of the last species of seabirds whose breeding sites remain unknown. This is one of the main reasons why it has been classified as 'Data Deficient' on the IUCN Red List (Birdlife International 2016). Therefore, finding and characterizing

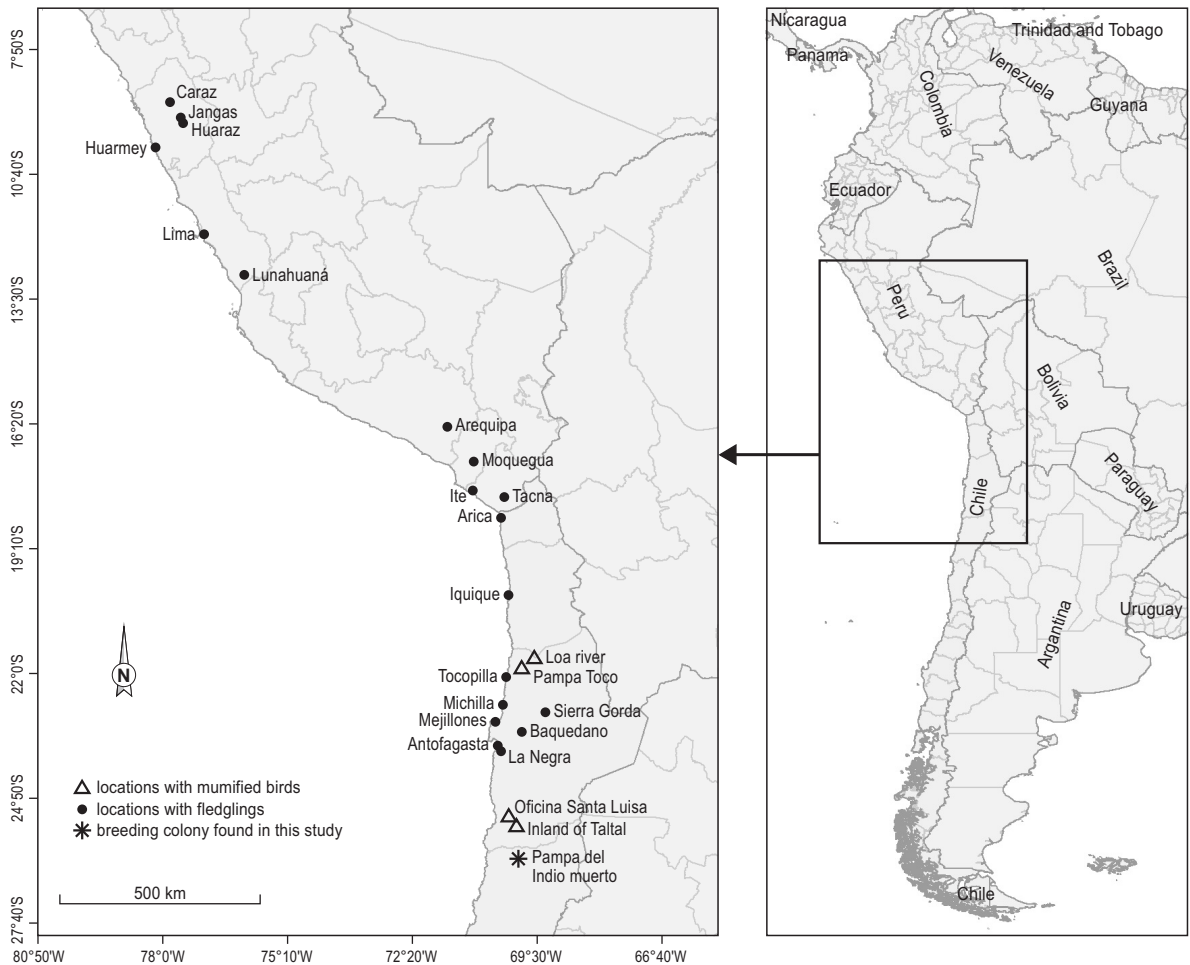


Figure 1. Map of inland records of Hornby's Storm Petrel in Chile and Peru, with the location of the first breeding site found in this study.

their reproductive colonies is a priority to enable an adequate assessment of their conservation status (Drucker & Jaramillo 2013).

A dead adult and juvenile were found in a cavity in 1894 in Taltal, in the Antofagasta region (Philippi 1895); a mummified specimen was discovered in 1923 in a nitrate mine near the Santa Luisa Office, about 50 km from the coast at 1600 meters above sea level, inland of Taltal (Stresemann 1924). Mummies were also found in nitrate deposits in Pampa del Toco, in the interior of Tocopilla, Antofagasta region, and in the Loa river basin, on the border between the regions of Tarapacá and Antofagasta (Wetzel 1925). These discoveries served as the basis for the early hypothesis that the species breeds in the Atacama Desert (Hellmayr 1932, Murphy 1936, Goodall *et al.* 1951).

This idea has been reinforced by the discovery of adults and fledglings attracted to lights in desert areas

of southern Peru: Huarney, Lima, Lunahuaná, Arequipa, Moquegua, Ite and Tacna (Koepcke 1964, Drucker & Jaramillo 2013, Murillo *et al.* 2013, eBird 2017, Jhonson Vizcarra pers. obs.), and of northern Chile: Arica, Iquique, Tocopilla, Michilla, Mejillones, Antofagasta, Baquedano, Sierra Gorda and La Negra (Brooke 2000, Brooke 2004, Gómez 2012, eBird 2017, and pers. obs. by Ronny Peredo, Vinko Malinarich, Verónica González, Bárbara Olmedo, and Silvia Hernández). Also, there are some records at high altitudes in Cordillera Blanca, department of Ancash, Peru: one at 2225 m a.s.l. in Caraz, another at 3800 m a.s.l. in the Jangas district (Drucker & Jaramillo 2013, Murillo *et al.* 2013) and at 3150 m a.s.l. in Huaraz (eBird 2017, checklist S13767880), which suggests that there may also be breeding sites at high altitudes.

Brooke (2000, 2004) assumed that the nesting period is between March and July, since most of the

fledglings attracted by lights are found between June and July. However, Spear & Ainley (2007) reported a female with an enlarged follicle in late November, suggesting that egg laying could start in December. The latter is consistent with the analysis of wing moult in adults, which suggests a reproductive season between January and June (Howell 2012).

With the objective of taking the first step towards increasing the knowledge of the breeding ecology of this bird, needed to assess the conservation status of the species, we organised field trips in the Atacama Desert, searching for breeding locations of the Hornby's Storm Petrel.

Methods

Between 2013 and 2017, a team of volunteers from Red de Observadores de Aves y Vida Silvestre de Chile (ROC) surveyed 780 linear km of the Atacama Desert in northern Chile, mainly searching for breeding sites of Markham's Storm Petrel *Oceanodroma markhami* (Schmitt *et al.* 2016). This process allowed us to create a clear search image that laid the foundations for the discovery of the breeding location that we report here, since both species breed in similar cavities (but Hornby's Storm Petrel breeds in gypsum cavities, while Markham's Storm Petrel breeds in salt-made cavities).

In December 2016, we surveyed the area of Pampa de Indio Muerto (26.204°S, 69.919°W), 20 km north of the city of Diego de Almagro in the Atacama Region, where we found natural shallow cavities with petrel odour and white and grey feathers inside. Although all the cavities were natural, sometimes they showed signs of active digging by petrels, who probably enhance the cavities to make them suitable for breeding. When we analysed the collected feathers (a wing feather and some body feathers), they coincided in size, colour and shape with a mummified specimen found earlier.

Between 1 and 3 April 2017, a team of four people visited the Pampa de Indio Muerto again, surveying an area of approximately 64 ha, 25 cavities were found with the same odour, some with remains of feathers inside, confirming the site as a breeding location of petrels (Figure 1). During the two nights that the team remained at the site, no vocalizations of petrels were heard. To verify which species was breeding, 50 × 50 cm mist nets were installed in the mouth of some cavities for two nights (four nets the first night and 10 nets the second night).

Results and Discussion

On the second night of mist netting at potential nests (2 April 2017), an adult specimen of Hornby's Storm

Petrel was captured leaving the burrow at 6:00 am, which confirmed the first nest ever found for this species (Figures 2A and 2B). The breeding location is situated at 1100 m a.s.l. and 75 km in a straight line from the coastline, located in what is known as the 'absolute desert' (Luebert & Plissock 2006). The area consists of an extensive pampa formed by a hillock of soil substrate, crossed by dry runoff streams (Figure 2C). The cavities were situated in low-slope hills since the flat areas are occasionally washed by landslides. The cavities were located in outcrops of gypsum, where there are natural cavities of unknown depths. The surveyed area is a minor part of a large area with relief and homogeneous substrate, so the breeding area could be much larger.

Following the discovery of this breeding location, potential threats were identified, such as development of mining and solar energy projects in the Atacama Desert, which could directly affect areas with nests, and incidental effects of artificial light on fledglings. These threats could be present both in the vicinity of the breeding location and on their flight routes to the sea.

This discovery will help orient future search efforts which should focus on locating and characterizing new breeding locations of Hornby's Storm Petrel, as well as increasing knowledge of the species' natural history, reproductive biology, population size and potential threats. For locating new breeding sites, it would be possible to use miniaturized radio telemetry, as was used by Rayner *et al.* (2015) to search for New Zealand Storm Petrels *Fregetta maoriana* (which are smaller than Hornby's Storm Petrels; an advantage in using these devices). To attract the birds in order to catch them on land, a combination of lights and call playback could be used (Ismar *et al.* 2015), although this would first require the recording of a Hornby's Storm Petrel's call. Also, efforts to assess the colony size are needed, since we surveyed only 25 nests in two days, but the breeding site is probably more extensive. For this purpose, transect counts can be used, as has been done for Markham's Storm Petrel (Rodrigo Barros, unpubl. data). Another priority is assessing how many fledglings are drawn off course by lights into cities and industrial sites, and how many die there, to evaluate if measures should be taken to prevent this. The re-evaluation of the species' conservation category based on adequate information (both in Chile as elsewhere), the effective protection of colonies and making an inventory of potential threats are fundamental steps for the conservation of the species, objectives that should be our goal in the short term.

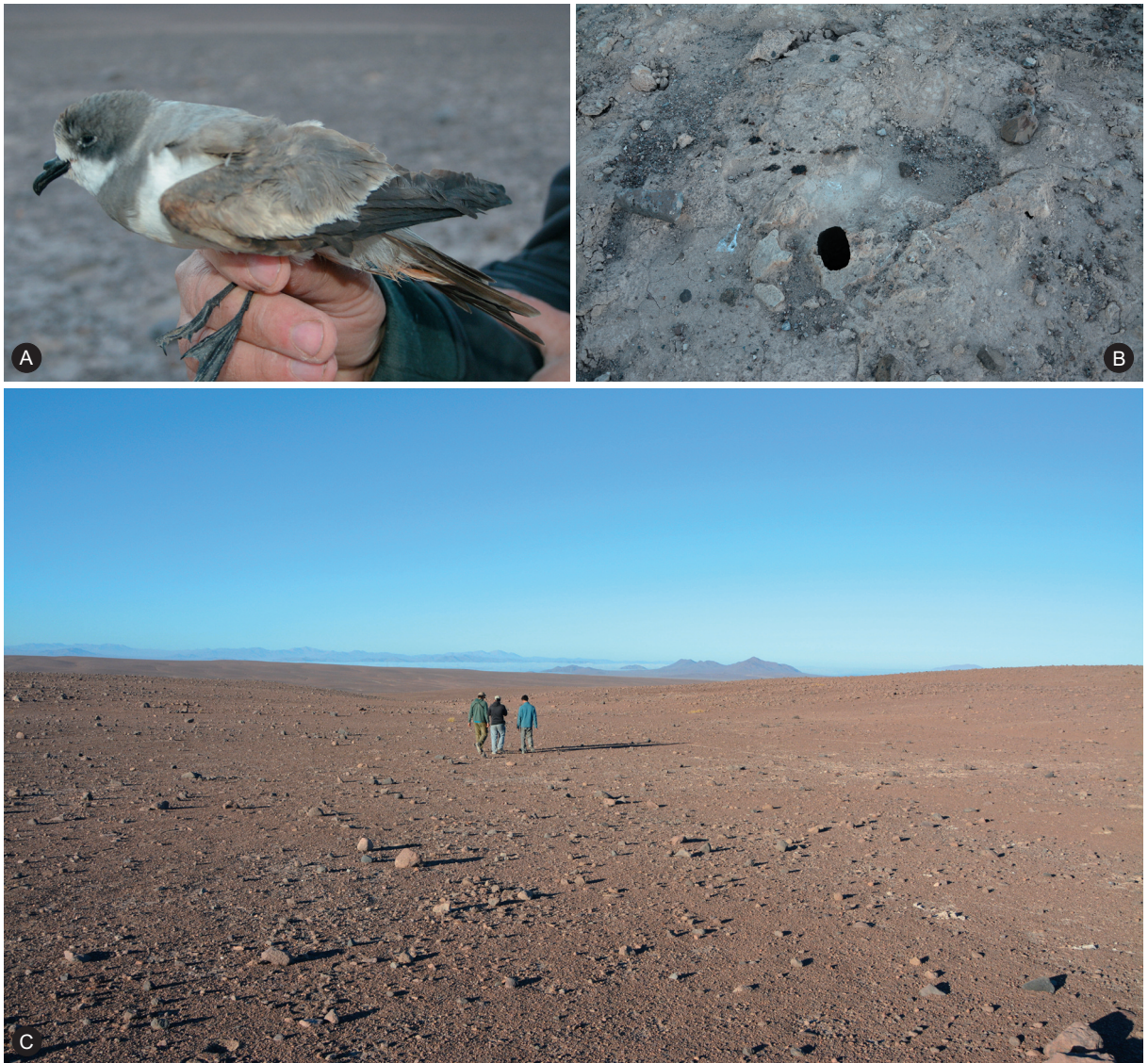


Figure 2. (A) Hornby's Storm Petrel captured using mist nets. (B) Cavity where the bird was caught. (C) Habitat where the breeding colony of Hornby's Storm Petrel is located (Pampa de Indio Muerto, Atacama Region, Chile, April 2017).

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References

- BirdLife International 2016. *Hydrobates hornbyi*. The IUCN Red List of Threatened Species 2016: e.T22698567A93690126. <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22698567A93690126.en> (accessed 31 October 2017)
- Brooke M. 2000. Report on a project supported by a BOU research grant. *Ibis* 142: 348–349.
- Brooke M. 2004. *Albatrosses and petrels across the World*. Oxford University Press, Oxford, UK, and New York, USA.
- Carboneras C. & Bonan A. 2017. Northern Storm-petrels (Hydrobatidae). In: del Hoyo J., Elliott A., Sargatal J., Christie D.A. & de Juana E. (eds) *Handbook of the birds of the world alive*. Lynx Edicions, Barcelona. www.hbw.com/node/52195

- Drucker J. & Jaramillo A. 2013. Ringed Storm-Petrel (*Oceanodroma hornbyi*), version 1.0. In: Schulenberg T.S. (ed.) Neotropical birds online. Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/nb.rispet1.01
- eBird 2017. eBird: An online database of bird distribution and abundance. Cornell Lab of Ornithology, Ithaca, NY. www.ebird.org
- Gómez G. 2012. Relación entre la presencia de la golondrina de mar de collar, *Oceanodroma hornbyi* (Procellariiformes; Hydrobatidae), iluminación artificial y fase lunar, en el norte de Chile, región de Antofagasta. Undergraduate thesis, Universidad de Antofagasta, Antofagasta.
- Goodall J.D., Johnson A.W. & Philippi R.A. 1951. Las aves de Chile su conocimiento y sus costumbres. Tomo Segundo. Platt Establecimientos Gráficos S.A., Buenos Aires.
- Hellmayr C.E. 1932. The birds of Chile. Zoological Series, Publication 308, Volume XIX, Field Museum of Natural History, Chicago, IL.
- Howell S.N.G. 2012. Petrels, albatrosses and storm-petrels of North America. Princeton University Press, NJ.
- Ismar S.M., Gaskin C.P., Fitzgerald N.B., Taylor G.A., Tennyson A.J. & Rayner M.J. 2015. Evaluating on-land capture methods for monitoring a recently rediscovered seabird, the New Zealand Storm-petrel *Fregetta maoriana*. Marine Ornithology 43: 255–258.
- Koepcke M. 1964. Las aves del departamento de Lima. Gráfica Morsom, Lima, Perú.
- Luebert, F. & Plissock P. 2006. Sinopsis bioclimática y vegetacional de Chile. Editorial Universitaria, Santiago de Chile.
- Murillo Y., Piana R.P. & Delgado-Alburquerque L. 2013. Rescate de Golondrinas de la Tempestad de Collar (*Oceanodroma hornbyi*) en la ciudad de Lima, Perú. Boletín UNOP 8: 55–64.
- Murphy R.C. 1936. Oceanic birds of South America. Vol. 2. MacMillan Company, New York, NY.
- Rayner M.J., Gaskin C.P., Fitzgerald N.B., Baird K.A., Berg M.M., Boyle D., Joyce L., Landers T.J., Loh G.G., Maturin S., Perrimen L., Scofield R.P., Simm J., Southey I., Taylor G.A., Tennyson A.J., Robertson B.C., Young M., Walle R. & Ismar S.M. 2015. Using miniaturized radiotelemetry to discover the breeding grounds of the endangered New Zealand Storm Petrel *Fregetta maoriana*. Ibis 157: 754–766.
- Philippi R.A. 1895. Neue Thiere Chile's. Verhandlungen des Deutschen Wissenschaftlichen Vereins zu Santiago de Chile 111: 9–23.
- Schmitt F., Barros R. & Norambuena H. 2016. Markham's Storm Petrel breeding colonies discovered in Chile. Neotropical Birding 17: 5–10.
- Spear L.B. & Ainley D.G. 2007. Storm-petrels of the Eastern Pacific Ocean: species assembly and diversity along marine habitat gradients. Ornithol. Monogr. 62.
- Stresemann E. 1924. *Oceanodroma hornbyi* (Gray) aus einem chilenischen Salpeterfelde. Ornith. Monatsber. 32: 63–64.
- Wetzel W. 1925. Vogelmumien und "Guano" in chilenischen Salpeterablagerungen: Zentralbl. Mineral., Geol. Palaontol. 1925, Abt. A: 284–288.

Samenvatting

Het Gekraagd Stormvogeltje *Oceanodroma hornbyi* is een endemische soort van het zeegebied van de Humboldtstroom langs de westkust van Zuid-Amerika. Er is nagenoeg niets bekend over de ligging van de broedplaatsen en de grootte van de populatie, zoals ook blijkt uit de classificatie van de status van de soort door IUCN ('Data Deficient'). Het is onbekend of de soort wordt bedreigd en als dat het geval is, welke beschermingsmaatregelen er nodig zouden zijn voor het behoud van de soort. Als onderdeel van het project 'Golondrinas del Desierto' begon in november 2013 in Chili een zoektocht naar kolonies van het Gekraagd Stormvogeltje. Het was bekend dat deze in de Atacama-woestijn broedt, omdat daar ooit gemummificeerde vogels waren gevonden en er in nabijgelegen kustplaatsen uitgevlogen jongen waren gevonden, die waren aangetrokken door het kunstlicht toen ze op weg waren naar zee. In dit artikel beschrijven we de ontdekking van de eerste broedplaats van de soort. De broedlocatie ligt op 75 km van de kust, op 1100 meter boven de zeespiegel, in het midden van de Atacama-woestijn (de droogste plaats op Aarde). Er is echter een sterke antropogene druk op deze woestijn als gevolg van mijnbouw- en zonne-energieprojecten. Om de vogels te beschermen is het belangrijk om de populatiegrootte van de kolonie te bepalen, nieuwe kolonies trachten te vinden en de bedreigingen voor elk daarvan in kaart te brengen. Ook moet onderzocht worden hoeveel jonge vogels worden aangetrokken door kunstlicht van steden en industrieterreinen en hoeveel vogels daardoor omkomen.

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