

A NEW BREEDING COLONY OF BLUE-FOOTED BOOBY *SULA NEBOUXII* AT ISLOTE GONZÁLEZ, ARCHIPELAGO ISLAS DESVENTURADAS, CHILE

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ABSTRACT

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We describe a new disjunct population of Blue-footed Booby *Sula nebouxii* at Isote González in the Islas Desventuradas archipelago. Though likely much larger, the population size at the time of our survey was a minimum of 16 breeding pairs. On 14–15 December 2020, two pairs of boobies with nestlings and four pairs with empty nests were found. Likely the species is a recent arrival to the archipelago, perhaps during one of the strong El Niño events between 1970 and 2001 (especially 1982/83, when the species was first recorded in Chile). Blue-footed Booby might also nest on different areas at San Félix Island and some smaller islets around the archipelago, where they would have no nesting-site competition from the larger Masked Booby *S. dactylatra*.

Key words: Blue-footed Booby, *Sula nebouxii*, breeding, Islas Desventuradas, Chile

INTRODUCTION

Within the Sulidae, a widespread and prolific group of piscivorous seabirds, there are three species of gannet and seven species of booby. Three of the booby species are pan-tropical, and the other four have a more restricted distribution (Nelson 2006, Dickinson & Rensen 2013). The Blue-footed Booby *Sula nebouxii* has a disjunct distribution and is considered by Nelson (1978, 2006) to be the second-rarest booby after Abbott's Booby *Papadusa abbotti*. The species frequents inshore habitats, confined to a narrow belt along the eastern Pacific Ocean (Nelson 1978, 2006). In the northern hemisphere, it breeds in Mexico at several islands in the Gulf of California and off the west coast; in the Gulf of Fonseca, Honduras; in the Gulf of Panama, Panama; and on Gorgona Island, Colombia. Stragglers have appeared in southern California and Arizona, USA, but also have occurred north to Vancouver Island, Canada (Nelson 1978, 2006; Dickinson & Rensen 2013). South of the Equator, besides the Galápagos Islands, there are some South American coastal breeding sites at the northern end of the cold Humboldt Current upwelling system. These include sites in Ecuador (Isla de la Plata (Ortiz-Crespo & Agnew 1992) and islands off the Gulf of Guayaquil) and Peru (the Lobos de Afuera Islands (06°56'S) (Nelson 1978, 2006) and Gualaquiza Island (08°32'S)). Sporadic breeding occurs during El Niño as far south as the Chiriquí Islands in Peru (13°44'S; Hughes 1992). Hughes also reported that immature Blue-footed Boobies are regular visitors in small numbers to the towns of Mollendo and Tacna in southern Peru (~18°00'S) during post-breeding dispersal, staying between May and October. During El Niño events, the number of birds visiting the area and the length of their stay increases, for both immatures and adults (Hughes 1992).

On 10 February 1983 during one of the strongest El Niño events on record, the species was reported for the first time in Chile, along the

northern coast between 21°54'S and 23°05'S (Guerra 1983). Guerra observed 10 individuals in a 132-km transect while surveying for guano birds and fur seals along the coast. A few birds occasionally occur in the extreme northern end of Chile, particularly in Arica (18°30'S), but this is not surprising because Hughes (1992) reported the species to be a regular visitor in the extreme southern end of Peru, at the border with Chile. Aguirre *et al.* (2009) reported the first occurrence of Blue-footed Booby breeding in Chile, at San Félix Island. They visited the archipelago three times: 20 June 2001, 15 December 2001, and 20 March 2003. Although Aguirre *et al.* (2009) provided no population numbers, they observed two birds but no nesting in June 2001, one nest with two adults and three eggs in the month of December (year unspecified), and no individuals in March 2003. The base commander at the Chilean naval station on San Félix Island reported to Aguirre's party that a nest with three eggs was active between September and December 2002.

METHODS

As part of a regional bird survey, we visited Isote González (26°18'S, 080°05'W) during 14–15 December 2020. The island, along with the larger islands of San Félix and San Ambrosio, is part of the Islas Desventuradas archipelago. Isote González is located about 927 km west of the port of Caldera in northern Chile. It is one of the smaller islands of the archipelago, all of which are volcanic in origin. It is roughly oval in shape, ~0.85 km long, and has a maximum width of ~0.50 km, narrowing to ~0.25 km at its northernmost end. The island has a maximum elevation of 166 m above sea level toward the southern end (Fig. 1). On the northern tip at an elevation of 100 m above sea level, there is a narrow 200 m long plateau of 0.76 hectares (0.0076 km²; area estimated using Google Earth ©2020). Most of the island, particularly the southern end, is composed of a thick layer of deep-yellow volcanic tuff. At the eastern side in the middle, the substrate is a granular, thick,



Fig. 1. Islote González, looking from east to the west. The southern end of San Félix Island can be seen to the extreme right of the image. (Photo by M. Marín.)

sand-like mix of the yellow tuff and jet-black basalt. The northern end of the island is dominated by the jet-black lava. The island has no surface water and only scanty shrub vegetation in the ravines of the eastern slope. To the north, a channel that is ~500 m wide with strong currents separates Islote González from Punta Bari, the southeastern tip of San Félix. The coast of Islote González consists of sheer cliffs on the north, west, and south sides while the east side has gentler slopes of 40–60°; the exception is the northeastern tip, which is a sheer 100-m cliff (Fig. 1). At the base of this cliff is the only possible boat landing site, and it is accessible only in relatively good weather conditions.

During our visit, we walked across ~45% of the island and scanned the remainder with 8× and 10× binoculars from strategic and high points. Islote González had never been visited by ornithologists before, due to its difficult access. The few that made it to the general area prioritized the bigger islands of San Félix and San Ambrosio (e.g., Chapin 1935, Jehl 1973, Aguirre *et al.* 2009).

On 10–12 December 2019, we visited San Ambrosio, which is the largest island of the group. Its coastline consists of sheer cliffs with an upper plateau at an elevation 200–300 m above sea level and a maximum elevation of 478 m above sea level. We traversed about 80% of the island and scanned the remainder from high points, searching for any avian species, breeding or not (for more details, see Marín *et al.* 2020). The distances and elevations were taken from marine charts: British Admiralty chart 4608 and Servicio Hidrográfico de la Armada (Chile) charts 510, 2410, and 2411.

RESULTS AND DISCUSSION

As soon as we landed on 14 December 2020, we encountered an apparent colony of Blue-footed Boobies. It contained six pairs, including two nests with nestlings. In one nest, the two nestlings were almost fully feathered and in the other, the two nestlings had white down, with visible feathers growing only on the wings and tail (Fig. 2). During the two days we stayed, the four other pairs were actively displaying at potential nesting sites. We do

not know if our visit was too early or too late in the season, but Blue-footed Boobies are likely not very synchronous in laying (Nelson 1978). During a previous trip to the area in December 2019, navy personnel from San Félix Island who were aboard our vessel showed us photos that were taken that same month of Blue-footed Boobies nesting at San Félix. Judging by the photographs, we estimated a minimum of 10 nests at all different stages, from eggs to well-grown nestlings. Aguirre *et al.* (2009) reported eggs only for December. Nevertheless, in a detailed examination of the breeding records for the Galápagos Islands, Nelson (1978) indicated that there seems to be two or three waves of egg-laying rather than



Fig. 2. A pair of Blue-footed Booby *Sula nebouxii* adults (right) with their downy young at Islote González on 14 December 2020. (Photo by MM.)

a single diffuse one. This might be the case at Islas Desventuradas. The colony on Islote González was in a small cliff area with a slope of 60–80°, but it contained several large semi-flat shelves where the birds were nesting, located 5–20 m above sea level. Judging by all photographs seen of Blue-footed Boobies from San Félix, it appeared that they nested mainly on the cliff edges and occasionally in the interior of the island. However, they were clearly segregated from Masked Boobies *Sula dactylatra*, which prefer flatter areas.

At Isla Española in the Galápagos Islands, where Masked and Blue-footed boobies nested together, Duffy (1984) found that Masked Boobies nested on cliff edges while Blue-footed nested more in the interior of the island—i.e., the reverse of our findings at Islas Desventuradas. At Isla de la Plata in Ecuador, Blue-footed Boobies were observed to nest on cliff edges and inland while Masked Boobies nested mainly at the interior of the island (Ortiz-Crespo & Agnew 1992; MM pers obs.). On the upper plateau at San Ambrosio during December 2019, we found only Masked Boobies nesting mainly inland and in all different stages, from fresh eggs to near fledglings. We do not know the real population size of Blue-footed Boobies at Islas Desventuradas, but there appears to be at least 16 breeding pairs between San Félix and Islote González, though the real number is likely larger. We did not detect the species at San Ambrosio, and we do not know if they might nest on other areas of San Félix or on the small islets around San Ambrosio, where there appears to be no Masked Boobies to compete for nesting sites.

Taylor *et al.* (2011) indicated that Blue-footed Boobies breed exclusively close to areas of cold-water upwelling associated with their main prey: sardines *Sardinops sagax* and anchovies *Engraulis ringens*. At Islas Desventuradas, there is likely some upwelling, judging by large changes in depth around the islands, particularly to the southeast and northeast. The sea surface temperature of the surrounding waters has been described as subtropical but having a seasonal shift to cooler temperatures with the incursion of subantarctic surface waters during the austral winter (Bahamonde 1987). During our two days at Islote González, we observed some of the birds plunging and foraging 50–100 m from shore, with a few departing in a northerly direction. We do not know what their prey items would be in these waters, as no anchovies or sardines are known in the area (e.g., Sepúlveda 1987).

We think that the presence of the Blue-footed Booby at Islas Desventuradas is recent. No expeditions that reported on the islands prior to 2000 mentioned them (Chapin 1935, Murphy 1936, Bahamonde 1965, Jehl 1973, Bahamonde 1974, unpubl. data from the United States National Museum's Pacific Ocean Biological Survey). If the species was present at San Félix, visitors would likely have noticed, as the birds now nest close to the only known landing site on the southwestern side of the island. The first records of Blue-footed Booby for the area were on 20 June 2001, when Aguirre *et al.* (2009) encountered two birds. They also reported a single nest with eggs in December but their data and dates are not clear, as they mention landing in San Félix in June and March but not in December, when they landed at San Ambrosio only (Aguirre *et al.* 2009 pp. 44). Most likely, the nesting information was based on a report from the base commander and not their own data.

The Blue-footed Booby breeding area closest to Islas Desventuradas is on the Lobos de Afuera Islands, Peru, 2140 km directly to the north. Lobos de Afuera is the largest breeding colony, with

~10000 breeding pairs, and it is the closest colony to the known Chilean colonies (Nelson 1978, 2006). The species dispersal from the colony is rarely more than 1000 km, except during El Niño years (Nelson 2006). Although the Blue-footed Booby is an inshore feeder (Nelson 1978, 2006), it travels farther to feed during El Niño events, in pursuit of prey that follow cooler waters masses (particularly the immature birds; e.g., Aid *et al.* 1985, Hughes 1992, Nelson 2006). There was a gap of three decades between the Islas Desventuradas visits of Jehl (1973) in 1970 and Aguirre *et al.* (2009) in 2001. Three very strong El Niño events occurred in the intervening years: 1972/73, 1982/83, and 1997/98 (NOAA 2021). In one of those events (likely the strongest, in 1982/83), some Blue-footed Boobies got pushed further south and west than in any previous El Niño events, as noted below, and an unknown number stayed and become residents in the area.

During the 1982/83 El Niño event, some birds moved the furthest south and west ever recorded, reaching Antofagasta at 23°S and likely Islas Desventuradas at 26°S (Guerra 1983), but we cannot find evidence of any birds reaching central Chile (between Coquimbo and Valparaíso). During the last very strong El Niño event of 2015/16, there were 30 Blue-footed Boobies recorded in Chile among 18 records, which were limited to two areas: around Arica (18°24'S) and from Coquimbo (30°00'S) to the mouth of the Maipo River (33°37'S), with none in between (Barros 2016). In addition, J. Aguirre found three immature birds on 03 July 2015 in Viña del Mar (33°00'S) (J. Aguirre pers. comm.). It is noteworthy that the 2015/16 records were primarily immature birds and mostly recorded in the months of June and July (austral winter). We think that the birds sighted during El Niño 2015/16 in the extreme north of the country likely originated from Lobos de Afuera, while the ones from central Chile are more likely to have originated from Islas Desventuradas. If the birds found in central Chile indeed originated from Lobos de Afuera, they would have had to arrive by moving along the coast, which would be far more distance than the 3100 km direct route; Islas Desventuradas is only 900–1100 km to the west.

We conclude that the Blue-footed Booby became established in the Islas Desventuradas archipelago during one of the strong El Niño events between 1970 and 2001, most likely that of 1982/83 when the species was recorded for the first time in Chile.

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