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Unveiling an Important Humboldt Penguin (*Spheniscus humboldti*) Breeding Colony in Perú and the Need for its Protection Against the Potential Impact of Guano Harvest

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Abstract.—Humboldt Penguins (*Spheniscus humboldti*) are globally Vulnerable due to the decline of the population and to a decline in the number of breeding sites in comparison to historical records. In 2010, we observed a few thousand Humboldt Penguins nesting in a surface-nest colony on Isla Santa Rosa in southern Perú. This number was unexpected because this site has never been listed as an important Humboldt Penguin breeding ground. We visited this island again in June 2011 and 2012, and counted 1,965 and 1,745 active nests, respectively. These numbers indicate not only the presence of at least 3,500-4,000 Humboldt Penguins, but places Isla Santa Rosa among the five largest Humboldt Penguin colonies within its entire range. The need for recognition of Isla Santa Rosa as a major Humboldt Penguin refuge is crucial for the conservation of the species, as the island has remained untouched from guano harvesting since 1996. This has resulted in a significant accumulation of guano likely to be legally collected in the next few years. Unsupervised guano harvesting could cause a Humboldt Penguin exodus and jeopardize the existence of this colony. Under this scenario, it is recommended that Isla Santa Rosa be closed to guano harvesting until a surveillance program to protect the Humboldt Penguins can be established and proven to work under the conditions found on Isla Santa Rosa. *Received 2 September 2014, accepted 9 April 2015.*

Key words.—Humboldt Penguin, Perú, *Spheniscus humboldti*, guano harvesting, conservation, seabird counts.

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There are concerns about the conservation status of Humboldt Penguins (*Spheniscus humboldti*) given the overall reduction in the number of breeding colonies and the underlying rapid decline in the population in comparison to historical records (International Union for the Conservation of Nature 2014). The global population size of the species has been recently estimated at 37,000-60,000 birds distributed in at least 73 colonies between Isla Foca in northern Perú and Isla Metalqui in southern Chile (Vianna *et al.* 2014). Surveys of a few sites during the last decade in north-central Chile (Luna-Jorquera *et al.* 2000; Simeone *et al.* 2003; Mattern *et al.* 2004) and in south-central Perú (Cárdenas-Alayza and Cardeña-Mormontoy 2012; De la Puente *et al.* 2013) indicate that local populations have at least tripled in number. However, any possible rebound must be interpreted with caution as historical Humboldt Penguin numbers may have been underestimated due to inconsistent census methods (Mattern *et al.* 2004). Even in an optimistic scenario of population increase, the main colonies are under latent threats

caused by entanglement in gill nets (Simeone *et al.* 1999; Majluf *et al.* 2002), poaching (Murphy 1936; Hays 1984), unsustainable tourism (Ellenberg *et al.* 2006; Skewgar *et al.* 2009) and introduced species (Simeone and Luna-Jorquera 2012) that make recovered populations susceptible to decline. Population crashes are expected when human activities are coupled with severe El Niño events such as those that occurred in 1982-1983 and 1997-1998 (Hays 1986; Paredes and Zavalaga 1998; Paredes *et al.* 2003). These threats led to the classification of the Humboldt Penguin as globally Vulnerable in 2013 (International Union for the Conservation of Nature 2014); the species has also been listed as Endangered in Perú by the National Service of Forestry and Wildlife Fauna, Ministry of Agriculture (De la Puente *et al.* 2013). The monitoring of important Humboldt Penguin colonies and the identification of new nesting sites are key actions for the evaluation of population trends, particularly because these birds are susceptible to rapid changes in distribution (Paredes *et al.* 2003; Vianna *et al.* 2014).

We visited Isla Santa Rosa in southern Perú in November 2010 and observed a few thousand Humboldt Penguins nesting on open scrapes excavated in guano (seabird excreta commercially exploited in Perú to be used as a fertilizer). This number was unexpected because Isla Santa Rosa has never been listed as an important Humboldt Penguin breeding ground in Perú (Hays 1984; Paredes *et al.* 2003; De la Puente *et al.* 2013; Vianna *et al.* 2014), and thus the identification of this large colony warranted a more rigorous quantification. Moreover, during the last 20 years Isla Santa Rosa has built up large amounts of guano that is likely to be harvested in the coming years. Disturbance during a guano harvesting campaign on Isla Santa Rosa would jeopardize the existence of the Humboldt Penguin colony. In this study, we used ground-based elevated photography and direct counts to estimate the population size of breeding Humboldt Penguins on Isla Santa Rosa. Our goal was to highlight the importance of this colony for the species' conservation both in a local and global context. We also examined the feasibility of undertaking a supervised guano harvest campaign on the island.

METHODS

This survey was undertaken on Isla Santa Rosa (14° 19.11' S, 76° 9.34' W; Fig. 1) on 12 June 2011 and 2 June 2012. Isla Santa Rosa is a 25.5-ha inshore barren island, with sea surface temperatures ranging between 12 °C and 16 °C (Mendo and Wolff 2003). Steep cliffs rising 20-30 m above the sea level form much of the island's coastline. The island is divided in two at high tide; the northern half is locally known as Santa Rosita. In this study, we refer to the other half as Southern Island (Fig. 1). The last guano harvest on Isla Santa Rosa took place in 1995-1996 when nearly 6,500 metric tons of guano were removed down to the bedrock (Agro Rural, unpubl. data). Since 1996, the island has remained undisturbed and more than 15,000 metric tons of guano has progressively built-up following a regular occupancy of large numbers of guano-producing Guanay Cormorants (*Phalacrocorax bougainvillii*) and Peruvian Boobies (*Sula variegata*) (Agro Rural, unpubl. data).

During our visits, the majority of Humboldt Penguin nests contained either incubating adults or small chicks. Humboldt Penguins used open scrapes for nesting on Southern Island, whereas other small groups on Santa Rosita nested under wooden crane platforms,

in guano burrows and inside a small cave located at the base of a hill. There were approximately 300,000-400,000 non-breeding Guanay Cormorants on Isla Santa Rosa at the time of our two visits, and they occupied 2.5-3.0 ha of Southern Island, surrounding the Humboldt Penguin colony. Thus, the counts started immediately after the majority of Guanay Cormorants departed to forage between 10:00 and 11:00 hr.

A visit to Santa Rosita was possible only in 2011 as the tides prevented access in 2012. We inspected all guano burrows and the cave located on Santa Rosita, counting all Humboldt Penguins and occupied nests. We conducted the counts of a small group of Humboldt Penguins nesting under the wooden crane platform from a distance > 5 m using binoculars (10 x50) because this group was more susceptible to human disturbance.

Humboldt Penguins are extremely shy and typically flee from human approach when nesting on surface nests. We estimated Humboldt Penguin nest numbers on Southern Island using ground-based elevated photography to avoid nest abandonment and subsequent depredation of surface nests contents by Belcher's Gulls (*Larus belcheri*) and Kelp Gulls (*L. dominicanus*). High-resolution digital photographs were taken with a Nikon CoolPix P510 camera from two 10- to 15-m high points: "House Spot" located on the roof of the island's tallest abandoned building and "Hill Spot" located on the summit of a 15-m rocky hill (Fig. 1). Both sites were located at the eastern and western extremes of the colony (240 m apart from each other). We photographed almost the entire colony at different angles from these vantage points with a set of sequential shots that were later stitched in nine or 10 panoramic images of different sections of the colony (each section was formed from six to nine sequential photos). The presence of adults brooding downy chicks, or incubating adults in full-prone or semi-erect postures defined an active nest. We counted all adults and nests by visual inspection of the digital photos. Counts during the early stage of breeding allowed an easy and quick identification of individual nests in the photographs.

RESULTS

We counted 3,346 adults and 1,965 active nests on both islands in 2011 and 3,485 adults and 1,745 active nests on Southern Island in 2012. In 2011, 97% of nests were categorized as open scrapes, all of them located on the cliff tops, slopes and plateaus of the windward side of Southern Island (Fig. 1). The remainder was represented by covered nests on Santa Rosita. The larger proportion of nests counted on Southern Island suggested that any underestimation of the entire Humboldt Penguin population in 2012 was minimal, particularly because we did not

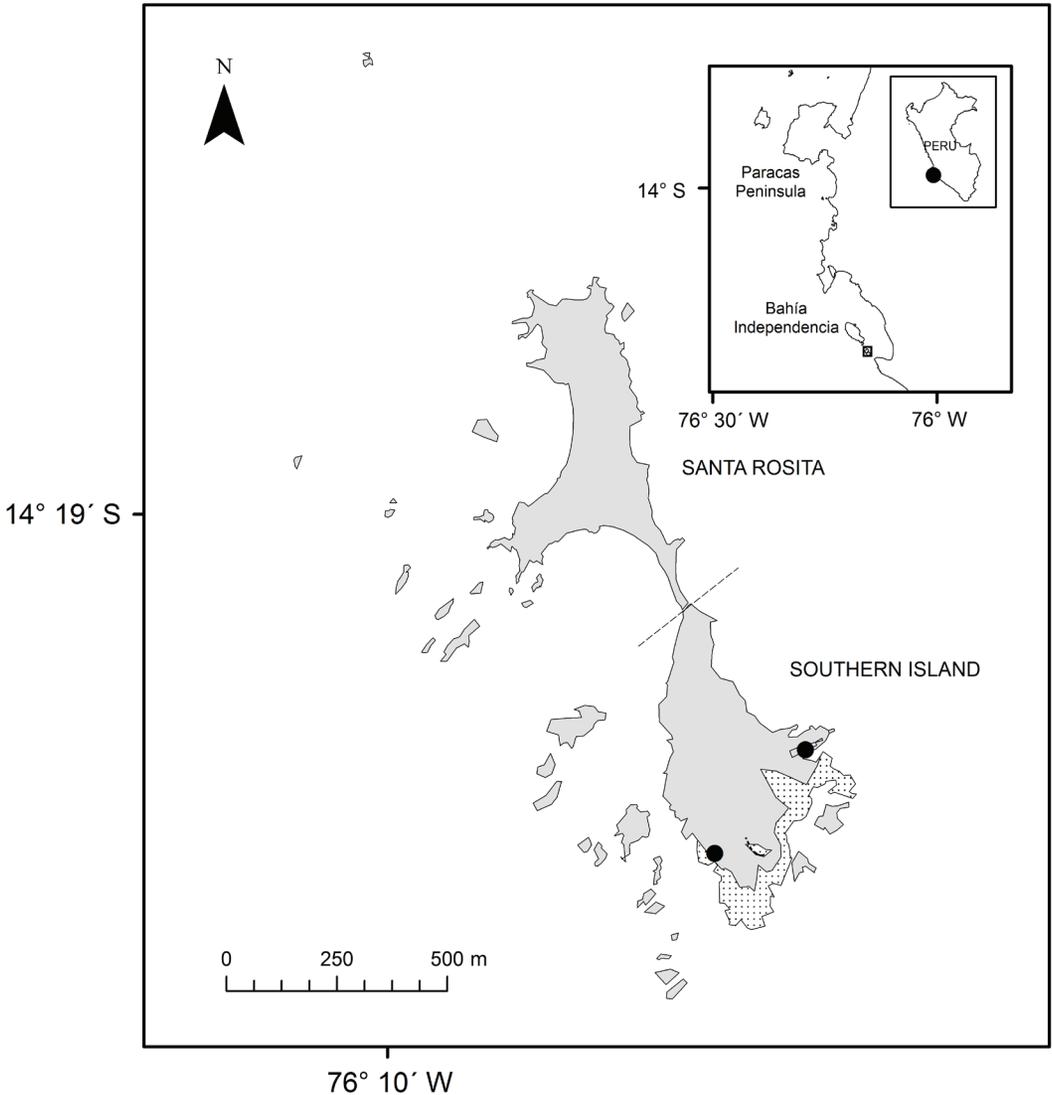


Figure 1. Location of Isla Santa Rosa. The black circles on Southern Island depict the location of the photographic spots. The dotted area represents the location and extent of the surface nest colony of Humboldt Penguins (*Spheniscus humboldti*). The dashed line delineates the break between the Santa Rosita and Southern Island portions of Isla Santa Rosa.

observe surface nests or colony expansion on Santa Rosita from a distance. The survey revealed that 75% of nests in 2011 and 72% in 2012 contained a full-prone adult, a semi-erect adult or an adult with visible small chicks (< 14 days old, only heads visible in the nest cup). The remainder of nests had adults guarding medium-sized chicks, but not older than 30 days of age (< 50% of the parent height). Very few nests had unguarded chicks. Only one juvenile (between 6 and

12 months old) was observed in both counts. The maximum extent of the surface nesting area was estimated at 2.94 ha, which represents 11.53% of the total area of Southern Island and Santa Rosita.

DISCUSSION

The results of this study indicate that Isla Santa Rosa hosts a breeding population of nearly 3,500-4,000 Humboldt Pen-

guins, making it not only one of the most numerous Humboldt Penguin colonies in Perú, but ranking it as one of the five largest breeding sites within the species' entire range (Vianna *et al.* 2014). Punta San Juan (located 150 km south of Isla Santa Rosa) has been recognized as the site with the largest number of Humboldt Penguins in Perú since the 1980s, with a maximum population of 4,421 birds in 2009 (De La Puente *et al.* 2013). The reported numbers at Punta San Juan and on Isla Santa Rosa are an order of magnitude higher than those at other Humboldt Penguin colonies in Perú (Hays 1984; Paredes *et al.* 2003; De La Puente *et al.* 2013). Thus, Isla Santa Rosa and Punta San Juan are currently the two major breeding refuges of Humboldt Penguins in Perú with a total number of approximately 8,000-8,500 birds. This is a significant number when taking into account that 4,870 Humboldt Penguins were counted in 35 localities (including Punta San Juan and Isla Santa Rosa) along the southern and central coast of Perú in 2000 (Paredes *et al.* 2003), and that the total number of wild Humboldt Penguins in Perú and Chile probably does not exceed 60,000 individuals (Vianna *et al.* 2014).

The colony of Isla Santa Rosa has remained unnoticed as an important breeding site because Humboldt Penguin numbers on this island apparently were historically low. In the early 1980s, no Humboldt Penguins were found on this site (Hays 1984) and only one individual was counted on the periphery of the eastern side of the island in 2000 (Paredes *et al.* 2003). The near absence of Humboldt Penguins on Isla Santa Rosa was corroborated in 2002 with the sighting of only four individuals (Apaza *et al.* 2002). These figures are not surprising given that Humboldt Penguins were exposed to the permanent presence of hundreds of guano harvesters on the island in 1995-1996. The disturbance and removal of nesting substrate were coupled with the occurrence of the 1997-1998 El Niño that caused massive mortality of Humboldt Penguins in other localities (Paredes and Zavalaga 1998; Apaza and Figari 1999). Based on counts reported between 2002 and 2008 during the Hum-

boldt Penguin breeding season (Ayala *et al.* 2007; Lleellish *et al.* 2007) and molting (McGill 2008), we can be certain that the population of Humboldt Penguins on Isla Santa Rosa experienced a 10-fold increase between 2006 and 2012 following a 6-year lag period between 2000 and 2005. This trend suggests that under isolation, cessation of guano harvest and favorable environmental and food conditions, Humboldt Penguin numbers can increase to establish important colonies.

Most of the seabird guano in Perú is produced by the Guanay Cormorant, the Peruvian Booby and the Peruvian Pelican (*Pelecanus thagus*). It has been commercially harvested since the 1840s, and it is still exploited on many islands and walled-off headlands along the Peruvian coast by Agro Rural, a governmental agency assigned by the Ministry of Agriculture. Under unsupervised conditions, guano harvesting has proved to have detrimental effects on seabird populations (Duffy 1994). In Humboldt Penguin colonies, it causes high levels of disturbance that precludes settlement, disrupts breeding or leads to nest desertions (Murphy 1936; Hays 1984). Chicks and eggs are abandoned, and adults are pushed to inaccessible beaches due to the constant presence of workers. Likewise, the removal of guano decreases reproductive success because Humboldt Penguins dig into guano layers to build their burrows (Battistini and Paredes 1999; Paredes and Zavalaga 2001). Thus, banning guano exploitation from main colonies or establishing sustainable guano harvest methods are major challenges for the protection of Humboldt Penguins in Perú.

In 2009, the Peruvian Government created the Guano Islands and Capes National Reserve, encompassing 22 islands and 11 capes and spanning 140,833 ha along the coast of Perú. This marine reserve is administered by the National Service of Natural Protected Areas (SERNANP, Ministry of Environment), and, following its creation, coordinated efforts between SERNANP, Agro Rural and private institutions have been made to launch monitoring programs to reduce the impact of guano harvesting on breeding seabirds and marine mammals. For instance,

the Center for Environmental Sustainability at Universidad Peruana Cayetano Heredia has successfully run a program to minimize the impact of guano harvest on the resident fauna at Punta San Juan in 2001, 2007 and 2012 (Cárdenas-Alayza and Cardeña-Mormontoy 2012). This program provides technical advice regarding the guano harvest schedules and operates an observer program to protect marked Humboldt Penguin nesting areas (Cárdenas-Alayza and Cardeña-Mormontoy 2012). The implementation of this program on Isla Santa Rosa is challenging given its geographic isolation, small size, unpredictable sea conditions and the lack of basic services (e.g., phone signal, medical attention, maritime transportation), which make logistic and safety planning extremely difficult for a large group of volunteers and supervisors. Under this scenario, we recommend the closure of Isla Santa Rosa to guano harvest until an alternative surveillance program to protect the Humboldt Penguins can be established and proven to work under the island conditions (e.g., surveillance cameras and video live streaming using satellite internet, reduced number of supervisors).

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