



## Seasonal Distribution of the Cocoli Heron (*Ardea cocoi*) and Great Egret (*Ardea alba*) in Southern South America: Evidence for Partial Migration

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### Abstract

The Cocoli Heron (*Ardea cocoi*) and Great Egret (*Ardea alba*) occur throughout South America with scant evidence of long-distance migration. We analyzed the seasonal distribution of these species based on 89,048 eBird records of the Cocoli Heron and 149,343 eBird records of the Great Egret south of 20° S from 1937–2022. Although individuals of both species occurred year-round at the highest latitudes (> 50° S), the proportion of records during winter (June to August) decreased significantly as latitude increased for both species, suggesting that the southernmost populations are partially migratory with some individuals migrating northward during fall and returning during spring. Further studies are needed to confirm whether these species migrate long distances in southern South America.

**Key words:** Argentina, Chile, eBird, migration, Neotropical austral migrants, Neotropics, Patagonia.

### Introduction

Bird migration within the Neotropics is complex (Jahn *et al.* 2020). Species that breed in the temperate latitudes of South America and migrate northward after the breeding season are referred to as austral migrants, Neotropical migrants, or Neotropical austral migrants (Chesser 1994, Hayes *et al.* 1994, Hayes 1995, Joseph 1997, Jahn *et al.* 2004, Cueto and Jahn 2008, Capllonch

2018, Jahn *et al.* 2020). Although the number of studies on these birds has increased in recent decades (Jahn *et al.* 2020), much remains to be learned about the seasonal movements of birds in southern South America.

Two species of *Ardea* herons breed in southern South America (Fig. 1). The Cocoli Heron (*Ardea cocoi*) breeds throughout much of South America (Kushlan and Hancock 2005, Martínez-Vilalta *et*



**Figure 1. Cocoi Heron at Laguna Capitán, Departamento Presidente Hayes, Paraguay, on 29 August 2016 and Great Egret at Janauari, Amazonas, Brazil, on 27 March 2014. Photos by Floyd E. Hayes.**

*al.* 2020). Post-breeding dispersal has been documented southward to the Strait of Magellan and to larger continental islands off the coast of South America, and some birds in the extreme south of its range are thought to migrate northward during winter (Capllonch *et al.* 2008, Capllonch 2018, Martínez-Vilalta *et al.* 2020). The Great Egret (*Ardea alba*) is a cosmopolitan species breeding throughout much of North America, South America, Eurasia, and Africa (Kushlan and Hancock 2005, McCrimmon *et al.* 2020). Although post-breeding dispersal occurs in all populations and migration is well documented in breeding populations of North America and Eurasia, migration is not known to occur among breeding populations of South America and Africa (McCrimmon *et al.* 2020), although it is suspected

to occur in South America (Capllonch *et al.* 2008, Capllonch 2018).

In the past two decades, eBird, an online citizen science database, has provided researchers with an enormous quantity of distributional records of birds that can be used for studying the seasonal distribution of birds (Sullivan *et al.* 2009, 2014, Wood *et al.* 2011). In this study, we use eBird data to examine the seasonal distribution of the Cocoi Heron and Great Egret within South America.

## Methods

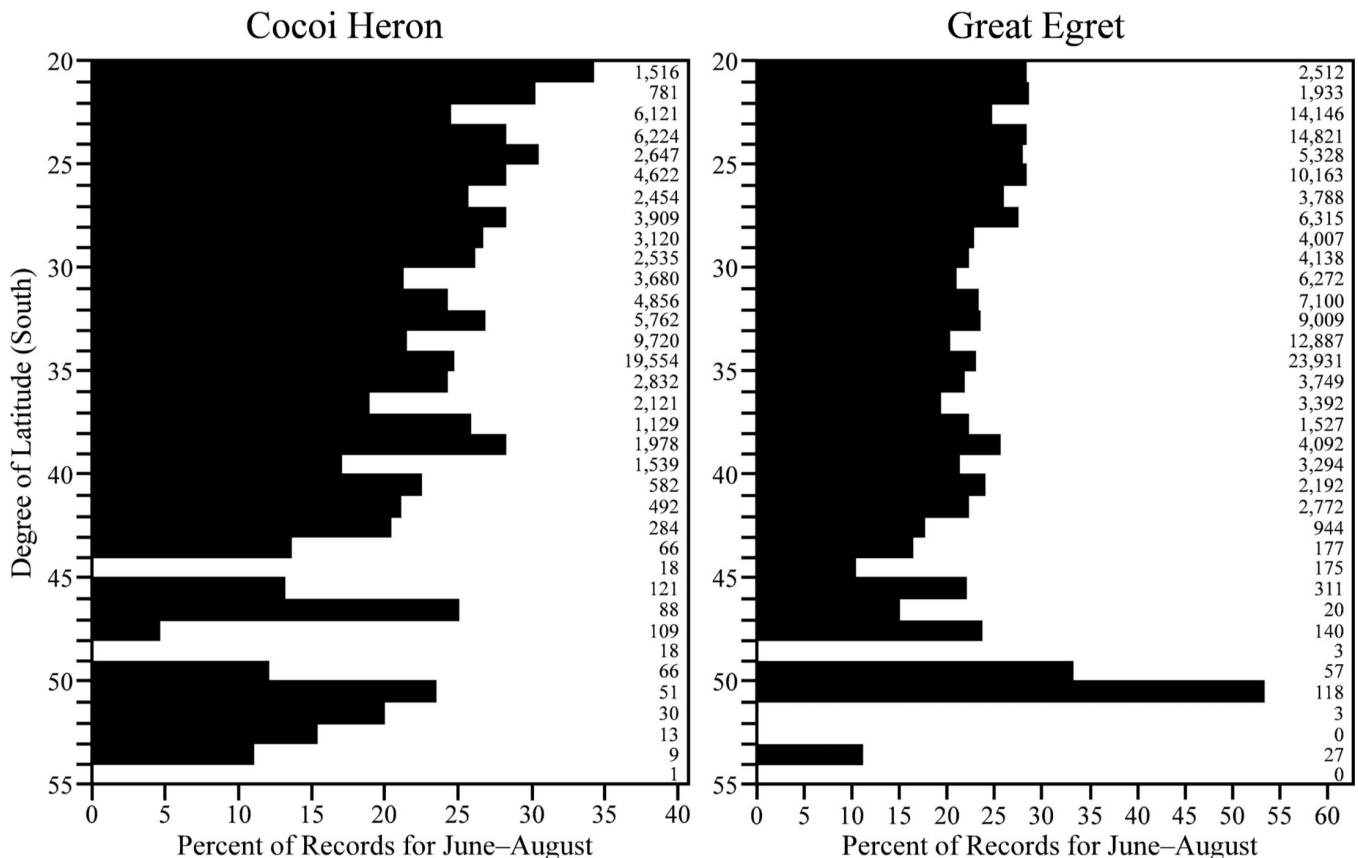
We downloaded all eBird records of the Cocoi Heron and Great Egret submitted and vetted by 21

October 2022 from south of 20° S in southern South America. Each record was defined as an observation of one or more individuals at a given locality (size of area highly variable) on a given date. For each degree of latitude south of 20° S, we calculated the percentage of records occurring during the winter months of June to August for each species. For each degree of latitude south of 45° S we calculated the percentage of records occurring during each month. A Cochran-Armitage test ( $\chi^2$  statistic; Cochran 1954, Armitage 1955) was computed using an online calculator ([epitools.ausvet.com.au/trend](http://epitools.ausvet.com.au/trend)) to test for a linear trend in the proportion of winter records for each degree of latitude. Google Earth ([earth.google.com/web](http://earth.google.com/web)) was used to estimate the approximate coordinates of the southernmost published records and eBird records, which were

often imprecise. An online calculator ([www.nhc.noaa.gov/gccalc.shtml](http://www.nhc.noaa.gov/gccalc.shtml)) was used to measure the approximate distances between the southernmost breeding colonies and the southernmost records.

## Results

We obtained 89,048 eBird records of the Cooi Heron from south of 20° S, ranging from 13 December 1937 to 30 September 2022. More than a quarter of the records at each degree of latitude occurred during winter to the north of 30° S and less than a quarter occurred during winter to the south of 30° S, with the proportion of winter records decreasing significantly as latitude increased (slope = -0.0035,  $\chi^2 = 147.94$ , df = 1,  $P < 0.001$ ; Fig. 2). The Cooi Heron occurred during



**Figure 2.** Percentage of eBird records (and total number of records at right) during winter (June to August) at each degree of latitude > 20° S from 1937-2022 in southern South America for the Cooi Heron and Great Egret.



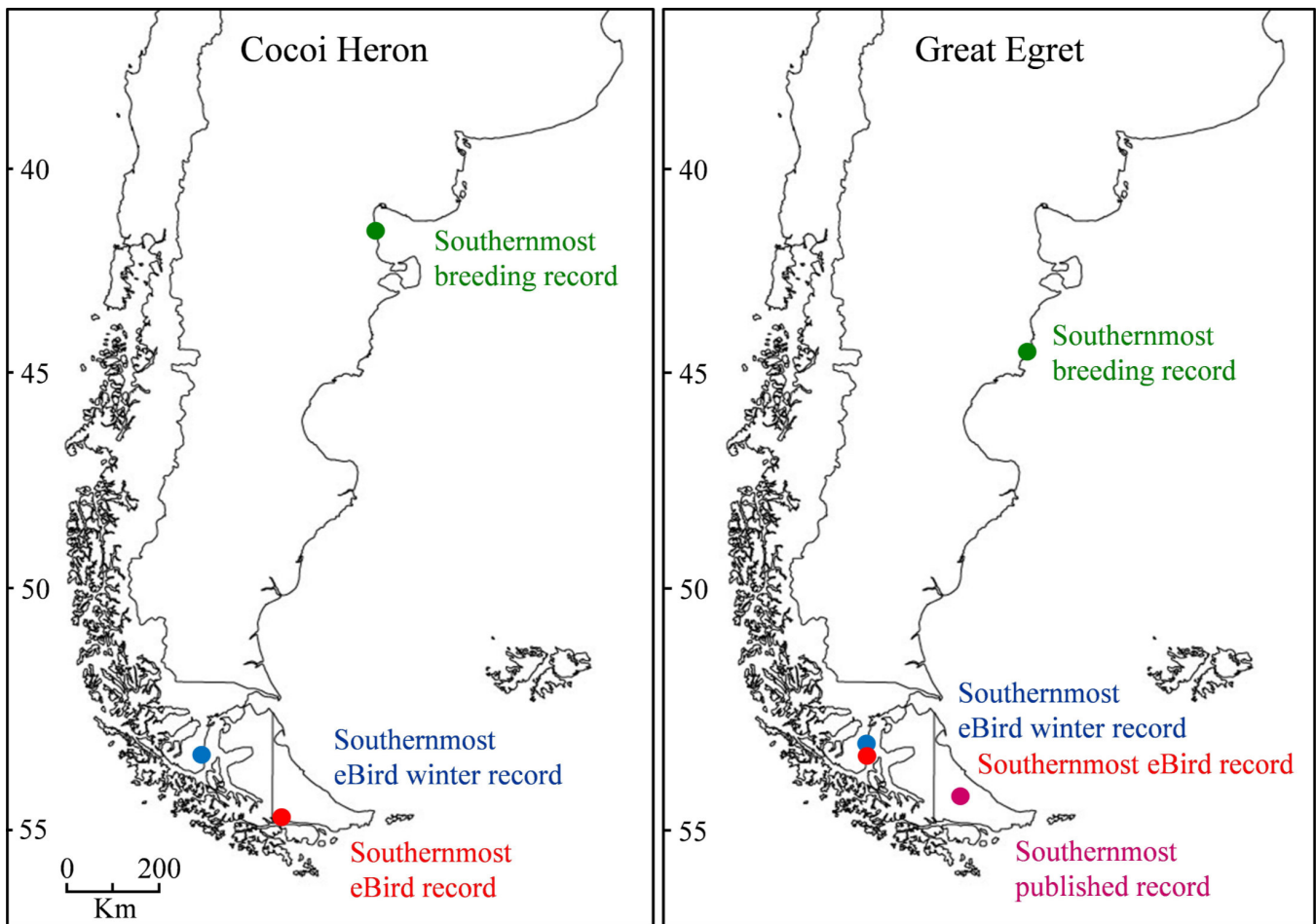
all months of the year at latitudes  $> 50^{\circ}$  S (Table 1). The southernmost eBird record was observed by Tom Ostrand from a bus while traveling along Route 3 from Ushuaia towards Parque Nacional Tierra del Fuego, Tierra del Fuego, Argentina ( $\sim 54^{\circ} 50' \text{ S}$ ,  $68^{\circ} 25' \text{ W}$ ; Fig. 3), and described as “standing at streamside, unmistakable large blue-gray heron, very similar to Great Blue Heron [*Ardea herodias*],” on 25 January 2017 (ebird.org/checklist/S34328721). The southernmost eBird winter record was an adult photographed by Julio Llanos at Río San Juan, Magallanes, Chile ( $\sim 53^{\circ} 39' \text{ S}$ ,  $70^{\circ} 57' \text{ W}$ ; Fig. 3), on 07 August 2020 (ebird.org/checklist/S72187594).

We obtained 149,343 records of the Great Egret

from south of 20° S, ranging from 13 December 1937 to 30 September 2022. About a quarter of the records at each degree of latitude occurred during winter to the north of 33° S and less than a quarter occurred during winter to the south of 33° S, with the proportion of records during austral winter decreasing significantly as latitude increased (slope = -0.0035,  $\chi^2 = 307.11$ , df = 1,  $P < 0.001$ ), even though more than half of the records ( $n = 118$ ) from 50-51° S occurred during winter (Fig. 2). The Great Egret occurred during all months of the year at latitudes > 50° S (Table 1). The southernmost eBird record was an adult photographed at the mouth of the Río Santa María, Magallanes, Chile (~53° 41' S, 70° 58' W; Fig. 3), by Sebastián Saiter Villagrán on 09 April 2022 (ebird.org/

**Table 1. Percentage of eBird records (1937-2022) for each month at each degree of latitude > 45° S in southern South America for the Cooi Heron and Great Egret.**

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**Figure 3.** Map of southern South America with locations of the southernmost breeding, winter and all-time records of Cocoi Heron and Great Egret.

checklist/S106708748) and by Santiago Imberti on 18 May 2022 (ebird.org/checklist/S110610440). The southernmost eBird winter record was observed by Melissa Carmody and Santiago Imberti at the mouth of the Río Agua Fresca, Magallanes, Chile ( $\sim 53^{\circ} 24' \text{ S}$ ,  $70^{\circ} 59' \text{ W}$ ; Fig. 3), on 07 June 2020 (ebird.org/checklist/S70182669, ebird.org/checklist/S70198376).

## Discussion

In southern South America, the Cocoi Heron breeds during September to December and the Great Egret breeds during October to January (De la Peña and Montalti 2014). There have been three

band recoveries of the Cocoi Heron up to 600 km to the south-southeast of where they were banded as chicks in Santa Fé Province in central Argentina, with the most distant recovery in January (Olrog 1965, 1968a). And there have been 12 band recoveries for the Great Egret up to 1,200 km to the north and 600 km to the south, mostly within 6 months of being banded as chicks in Santa Fé Province in central Argentina (Olrog 1965, 1968a, 1969, 1973). Most of these band recoveries of the Great Egret, including the most distant, were to the south during February to March and to the north during April to August. The seasonal patterns of dispersal demonstrated by these band recoveries are consistent with long-distance latitudinal migration by Neotropical

austral migrants (Capllonch *et al.* 2008, Capllonch 2018), but do not conclusively demonstrate a cyclical pattern.

The seasonal movements of waterbirds in southern South America are also influenced by hydrological regimes (Beltzer and Neiff 1992, Hayes 1996). For example, the abundance of both the Cocoli Heron and Great Egret is negatively correlated with water level along the Paraguay River (Hayes 1996) and Parana River (Beltzer and Neiff 1992). The herons disperse toward major rivers when water levels are low, when concentrated food resources occur in smaller pools and mudflats. And the herons disperse away from major rivers to other wetlands when water levels are high and food sources are more dispersed. This cyclical pattern of dispersal, in contrast with unidirectional dispersal, represents a localized and poorly documented form of migration.

Although many species of birds are expanding their ranges southward in Argentina in response to climate change (Capllonch *et al.* 2020), there is no evidence that the Cocoli Heron and Great Egret are expanding their breeding ranges southward. The southernmost known breeding colony of the Cocoli Heron is at Islote de los Pájaros, Río Negro, Argentina ( $\sim 41^{\circ} 27' \text{ S}$ ,  $65^{\circ} 02' \text{ W}$ ; Fig. 3), where it was first recorded breeding in 1995 (De la Peña and Montalti 2014, De Lucca *et al.* 2022), and the southernmost known breeding colony of the Great Egret is at Punta Lobería, Chubut, Argentina ( $\sim 44^{\circ} 35' \text{ S}$ ,  $65^{\circ} 24' \text{ W}$ ; Fig. 3), where it was first recorded breeding in 1982 (De la Peña and Montalti 2014). It is possible that new breeding colonies farther south have been overlooked.

Individuals of both species wander far south of their breeding colonies, with the southernmost eBird record of the Cocoli Heron about 1,507 km south of the southernmost known breeding colony and the southernmost eBird record of the Great

Egret about 1,085 km south of the southernmost known breeding colony. Both species occasionally disperse shorter distances ( $> 1,100 \text{ km}$  for Cocoli Heron,  $> 750 \text{ km}$  for Great Egret) from their nearest breeding colonies to the Falkland Islands (Wace 1921, Olrog 1968b, Woods 1975). These data demonstrate long-distance dispersal by both species in southern South America, indicating that they are capable of long-distance latitudinal migration.

There is no evidence that the Cocoli Heron and Great Egret are expanding their non-breeding ranges southward. There are numerous published records, including winter records, of the Cocoli Heron south of  $50^{\circ} \text{ S}$  during the past century (Venegas 1973, 1982, Venegas and Jory 1979, Clark 1986, Imberti 2003, 2005), with the southernmost eBird record (in 2017) only about 125 km south of a record from nearly a century earlier (in 1922) at Cabo Peñas, Tierra del Fuego, Argentina ( $53^{\circ} 51' \text{ S}$ ,  $67^{\circ} 33' \text{ W}$ ; Venegas 1973), and about 72 km south of an undated record prior to 1986 at Lago Cami, Tierra del Fuego, Argentina ( $54^{\circ} 34' \text{ S}$ ,  $67^{\circ} 24' \text{ W}$ ; Clark 1986). Venegas and Jory (1979) stated that most of these records were of solitary individuals during June and July. There are also many published records of the Great Egret south of  $50^{\circ} \text{ S}$  (Olrog 1948, Venegas 1982, Venegas and Jory 1979, Clark 1986, Darrieu *et al.* 2008) and a few of these are farther south than the southernmost eBird record of Great Egret (in 2020), including Río Grande, Tierra del Fuego, Argentina ( $\sim 53^{\circ} 48' \text{ S}$ ,  $67^{\circ} 45' \text{ W}$ ; Clark 1986) and Río Ewan, Tierra del Fuego, Argentina (somewhere between  $54^{\circ} 07' \text{ S}$ ,  $67^{\circ} 09' \text{ W}$  and  $54^{\circ} 24' \text{ S}$ ,  $67^{\circ} 22' \text{ W}$ ; Fig. 3; Clark 1986). Because these records are so close to the southern tip of South America (about 100 km from the southernmost record of Cocoli Heron), there is little space for non-breeding individuals to move farther southward, although the number of individuals dispersing south of  $50^{\circ} \text{ S}$  may be increasing as a

consequence of climate change.

The eBird data demonstrate that some individuals of both species linger throughout the winter south of 50° S and obviously do not migrate northward during fall, although they must eventually fly northward to breed. Both species appear capable of finding sufficient prey to survive harsh Patagonian winters. However, the proportion of winter records decreased steadily as latitude increased for both species, suggesting that some individuals in the southernmost populations are partially migratory with some individuals migrating northward during fall and returning during spring. Records from eBird reveal that some individuals in migratory populations of Great Egret in North America and Eurasia are capable of surviving for extended periods during winter at even higher latitudes, with the northernmost record at Kuljunlahti, Raahe, Finland (64° 38' N, 24° 26' E), from 2 January to 14 February 2019 (Kari Varpenius; [ebird.org/checklist/S51205940](http://ebird.org/checklist/S51205940), [ebird.org/checklist/S52674205](http://ebird.org/checklist/S52674205)). Further studies of herons that are banded, tagged with light-level geolocators, or outfitted with satellite transmitters are needed to confirm whether some individuals of the Cocoi Heron and Great Egret exhibit long-distance latitudinal migration in southern South America.

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