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Authors: Chupil, Henrique, and Monteiro-Filho, Emygdio Leite de Araujo

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## History of the Scarlet Ibis *Eudocimus ruber* in south and south-east Brazil

by *Henrique Chupil & Emygdio Leite de Araujo Monteiro-Filho*

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**SUMMARY.**—In Brazil Scarlet Ibis *Eudocimus ruber* occurs mainly in the north, south-east and south. During the 1900s, there was a significant reduction in the number of records in the latter two regions of the country, but this began to change in the early 1980s, when numbers of Scarlet Ibis gradually started to increase over the years. We contextualise the history of the species in south and south-east Brazil, and discuss the causes for its apparent disappearance and reappearance in these regions. We believe that anthropogenic factors, coupled with the species' ecology, were responsible for the reduction and subsequent resurgence of Scarlet Ibis.

Scarlet Ibis *Eudocimus ruber* is one of the most emblematic birds in the Americas, occurring across northern and eastern South America, from northern Colombia to Trinidad, the Guianas and coastal Brazil, with small outlying populations in Panama and Ecuador (Hancock *et al.* 1992). In Brazil, there are two disjunct populations: one in the north, in the states of Pará, Amapá and Maranhão; and the other in the south, in São Paulo, Paraná and Santa Catarina (Sick 1997).

Its occurrence in Brazil was first mentioned as long ago as the 16th century, with reference being made to the use of the species' feathers by indigenous craftsmen in what is now the state of São Paulo (Staden 1557), while later in the second half of the 16th century the Jesuit Fernão Cardim (Cardim 1925) and Portuguese historian and chronicler Pero de Magalhães Gândavo (Gândavo 1576) both referred to the Scarlet Ibis, especially its striking plumage.

Subsequently, in Santa Catarina the first reports date from 1712 and 1763, representing the southernmost historical records (Haro 1990). In Paraná, according to Straube (2005), the first 'mention' of Scarlet Ibis dates from 1653—in an illustration of Paranaguá Bay by José Teixeira Albermás II. Thereafter, more specific references to the species' occurrence in the state came from Johann Natterer in 1820, on the basis of the specimens that he collected and later deposited in Vienna (Naturhistorisches Museum Wien) and the reports of Augustin Saint-Hilaire between 1820 and 1855, also in Paranaguá Bay, near the mouth of Nhundiaquara River and in the environs of Guaratuba (Straube 2012).

Further historical records of Scarlet Ibis in this region of Brazil were made in the early 20th century, by A. R. Martins, on the coast of Paraná (Straube 2015), and by the engineer and naturalist R. Krone, around Iguape (on the south coast of São Paulo state) during the rainy season (Olmos & Silva e Silva 2003). However, with respect to Santa Catarina, by the time Naka & Rodrigues (2000) discussed the species, they believed it to have been extinct in the state for *c.*150 years.

Thereafter, in the 20th century, published data suggested that only a very small population was present in south-east Brazil, based on the isolated records available (Lago-Paiva 1994, Teixeira & Best 1981). For example, in 1961 when an individual was collected at São Vicente, in coastal São Paulo, it was considered the first record in south-east Brazil following decades of absence (Lago-Paiva 1994). For Paraná, there was only the report by

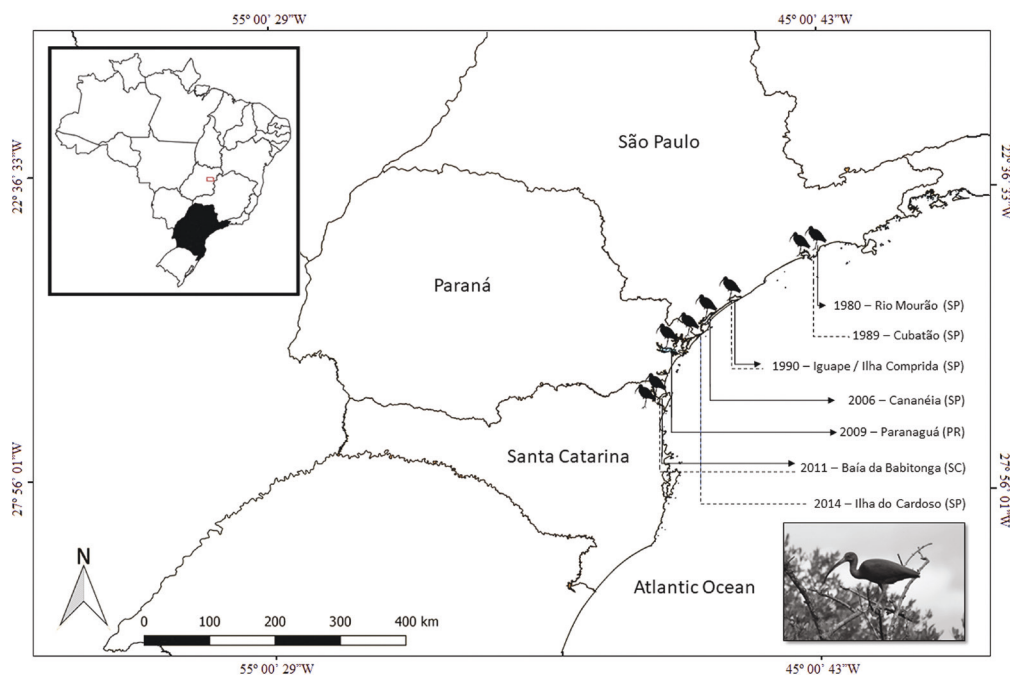


Figure 1. Map depicting the chronology of Scarlet Ibis *Eudocimus ruber* records since the 1980s in south and south-east Brazil. Dotted lines refer to breeding records. Arrows indicate records of individuals or groups.

P. Scherer-Neto, from 1977, involving three individuals in the municipality of Paranaguá (Teixeira & Best 1981).

Only in the early 1980s did this start to change, when Scarlet Ibis was observed again, initially around Santos (Rio Mourão) on the coast of São Paulo (Silva-Silva 2007; Fig. 1) and in 1989 nesting was confirmed in the municipality of Cubatão (Marcondes-Machado & Monteiro-Filho 1990). The population increased gradually and, in 1998, 385 individuals were estimated at the Santos mangroves (Olmos & Silva-Silva 2001). In the south of the same state, the first individuals and evidence of breeding occurred in Iguape and northern Ilha Comprida in the early 1990s (Bokermann & Guix 1990, Paludo *et al.* 2004, 2005). In 2006, the first individual was observed at Cananéia, with Roseate Spoonbills *Platalea ajaja* (ELAM-F pers. obs.). The first flocks were seen in the following year, and the species rapidly became more frequent. In 2007, of the 15 species recorded monthly in the São Paulo Bagre, Cananéia, Scarlet Ibis was the third most abundant (Coelho 2009). In 2009, 971 were estimated foraging in five areas around Cananéia and Ilha Comprida (Barbieri 2009), while during 2011 *c.*1,000 individuals were counted in the channel (Mar de Dentro) between Cananéia and Ilha Comprida (Noguchi 2011). Since 2014, a new colony has become established at the south end of Ilha do Cardoso and, in 2015, we estimated 1,000 birds were breeding there (HC & ELAM-F pers. obs.).

Paralleling the increase in records on the south coast of São Paulo, several birds were also observed in Paraná, in mangroves of the Paranaguá estuarine complex, where the species became more frequent from 2009 (Krul *et al.* 2009, Krul 2011). Estimates at different points in the Paranaguá estuarine complex produced a max. 225 individuals at one of the study sites between October 2012 and September 2013 (Vigário 2014). In November 2011, the first birds were observed on the north coast of Santa Catarina, with a breeding colony in Babitonga Bay (Fink 2013, Grose 2016).

The history of Scarlet Ibis around Cananéia and elsewhere in São Paulo, Paraná and Santa Catarina leads us to speculate as to the factors responsible for the paucity of records prior to the 1980s. Anthropogenic factors, such as degradation and reduction of mangroves in these southern states, affecting its foraging and breeding areas (Hass 1996, Olmos 2000), hunting for its beautiful plumage (which was historically coveted by both indigenous and immigrant European peoples) and egg collection (Lago-Paiva 1994, Rodrigues 1995, Hass *et al.* 1999) are generally cited as being responsible. It is also noteworthy that during the first half of the 20th century there were many fewer naturalists and researchers, which could explain the small number of records of Scarlet Ibis. However, even reports by resident observers were scarce, which is unexpected given that the species is unmistakable and obvious, as evidenced recently by local people in the Cananéia region.

Based on this, we consider the species vulnerable to anthropogenic activities. However, its current range includes colonies and frequent records in urban environments that are more or less disturbed, such as Ilha Comprida, Iguape, Babitonga Bay, Cubatão and Cananéia. In the latter, the species is periodically observed foraging beside a road well used by people and vehicles (plus boats on the river), and does not appear to be disturbed by human presence. With respect to hunting and egg collection, our conversations with local people in Cananéia and on Ilha do Cardoso have revealed no consumption of Scarlet Ibis eggs, nor any interest in hunting the species for its feathers or keeping it in captivity, neither now nor in past decades.

Therefore, are anthropogenic factors alone responsible for the species' apparent temporary local extinction on the southern Brazilian coast? Perhaps it would be more pertinent to believe that anthropogenic activities could have caused a population decline, but not extinction, yet leading to individuals or small groups dispersing to more remote areas along rivers and in mangroves, in search of safe foraging and breeding sites. Supporting this hypothesis is that as long ago as 1781, Martim Lopes Saldanha issued an edict for the protection of Scarlet Ibis, in which he stated that the species would almost certainly become extinct at some localities in Paraná, with apparent dispersion to more isolated islands (Straube 2011). In addition, it is important to highlight an important issue often overlooked when seeking to understand the dynamics of species, namely that periods of lesser abundance or greater dispersal, in the present case aggravated by anthropogenic factors, might be normal facets of their ecology.

An example of fluctuations in the numbers of Scarlet Ibis over a short period of time was obtained during monitoring of the breeding colony at the south end of Ilha do Cardoso, where approximately 1,000 birds bred in 2015 / 16, but just 300 in 2016 / 17. Concerning dispersal, it is interesting to mention the variation in numbers of Scarlet Ibis recorded during our twice-weekly boat-based surveys of the channel separating Ilha do Cardoso from Ilha de Cananéia (São Paulo) and Ilha do Superagui (Paraná) since 2014. On several occasions we covered the 46-km transect without observing any birds, whereas on others we counted >300. Apparently, the birds tends to be more visible at low tide and to disperse further during the non-breeding season. However, under the same tidal regime, at any season there is still marked variation in the numbers observed.

Additionally, the hypothesis of greater dispersal prior to the 1980s contrasts with the fact that Scarlet Ibis is generally conspicuous and unlikely to go unnoticed. However, again our regular surveys found that the species can be initially overlooked during cursory observations, but that careful checking would reveal small groups or lone individuals inside dense mangroves, where they might easily pass unnoticed if no effort was made to partially penetrate the habitat. Thus, when the species avoids more open areas it is much less conspicuous.

However, if the Scarlet Ibis really did become locally extinct as a breeder, from where does the current population in the states of São Paulo, Paraná and northern Santa Catarina originate? Genetic analyses comparing the population at Cubatão with those in northern Brazil demonstrated a close relationship, suggesting either that southern birds derived from the north or that the species at one time was found virtually throughout the Brazilian littoral (Gonçalves *et al.* 2010).

Olmos (2003) reported the introduction of 19 pairs of Scarlet Ibis from the state of Maranhão to Cubatão in 1967–69, which would corroborate the first hypothesis of Gonçalves *et al.* (2010), i.e. that southern birds derive directly from northern Brazil. However, the release of these individuals alone seems unlikely to account for the current population in south-east Brazil. The second hypothesis presented by Gonçalves *et al.* (2001), namely that the species formerly occupied the entire Brazilian coast to the limit of mangrove occurrence, equally accounts for the currently disjunct populations' close genetic similarity.

Under the current scenario, some dispersal of birds along the coast is evidenced by records from various localities, ensuring gene flow between, and reinforcing the genetic proximity of, different subpopulations in south-east Brazil (Gonçalves *et al.* 2010). An example of such movements was reported by Grose (2016), involving birds ringed in Babitonga Bay in November 2012, January 2013 and November 2013 that were subsequently re-sighted in Cananéia (August 2013 and May 2015) and the municipality of Praia Grande (October 2014).

Given the available information as to the history of occurrence of Scarlet Ibis and its ecological characteristics, we believe that the species previously occurred over a much greater part of the Brazilian coast with strongholds in the north and south—as already mentioned by Sick (1997)—but with some movement between areas. By and during the early 1900s, due to anthropogenic factors and the species' ecology, the southern population was both reduced in numbers and favoured more isolated mangroves. However, during the 1980s, the population began to increase and become more obvious again. We conclude that the species' biology may also explain its temporary apparent rarity and local extinction in parts of southern and south-east Brazil, as well as anthropogenic factors. Nevertheless, the conservation of estuaries where the birds breed and forage is essential to maintain the species' populations, despite that Scarlet Ibis appears to some extent tolerant of human disturbance and activities.

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- Addresses:* Henrique Chupil and Emygdio Leite de Araujo Monteiro-Filho, Programa de Pós-Graduação em Zoologia, Departamento de Zoologia, Universidade Federal do Paraná, Centro Politécnico, C.P. 1901, Curitiba, Paraná, CEP 81.530-990, Brazil; and Instituto de Pesquisas Cananéia, Avenida Nina 523, Cananéia, São Paulo, CEP 11.990-000, Brazil, e-mail: hchupil@gmail.com