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ARTICLE

The return of the Scarlet Ibis: first breeding event in southern Brazil after local extinction

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ABSTRACT: Here we describe the first breeding event of the Scarlet Ibis (*Eudocimus ruber*) in southern Brazil after a long period of local extinction. The species reproduced in a mixed colony on Jarivatuba Island, a mangrove area in Babitonga Bay, northern Santa Catarina. During the breeding season, between August 2011 and March 2012, regular surveys were carried out in the area with a powerboat to collect basic information on the species breeding. The first adult was recorded in November 2011, along with a group of White-faced ibises (*Plegadis chihi*) that was nesting at the same site. In January 2012, the local Scarlet ibises displayed reproductive behavior, with adults in incubation position in the nests. The first chicks were recorded on January 20, 2012. In March 2012, there were few adults in the colony, and juveniles were recorded in flight groups, including some outside the colony. Although there is no on-site housing, the region is very disturbed, with industries and marinas nearby, and it suffers from the discharge of domestic and industrial effluents. The creation of a local protected area would be an adquate long-term strategy for the conservation of the Scarlet Ibis and this ecosystem.

KEY-WORDS: Colony, *Eudocimus ruber*, mangrove, Santa Catarina State.

INTRODUCTION

The Scarlet Ibis, *Eudocimus ruber* (Linnaeus, 1758) is considered one of the prettiest birds on the planet (Sick 1997, Silva and Silva 2007). It inhabits mostly the coastal mangroves and wetlands in northern South America, in countries such as Colombia, Venezuela, Trinidad and Tobago, Suriname and Guyana (Olmos & Silva and Silva 2003). In Brazil, there are populations in the northern region (Amapá, Pará and Maranhão states), in the northeast (Piauí, Ceará and Bahia states) and the other is in the south-southeast region (Rio de Janeiro, São Paulo, Paraná and Santa Catarina states) (Teixeira *et al*. 1990; Olmos & Silva and Silva 2003, Lima *et al*. 2007, WikiAves 2015). The south-southeast population of the Scarlet Ibis has suffered a great decline in numbers and disappeared from many places in the last decades (Sick 1997). There are no documented and satisfactory explanations about the causes of local extinctions (Teixeira *et al.* 1990), but the most likely reasons are believed to be the collecting of eggs and feathers, capture of chicks and adults, and the destruction of mangrove areas (Sick 1997,Gonçalves *et al.* 2010).

The last records of the Scarlet Ibis in Santa Catarina State were in 1712 and 1763 in Florianópolis, and in 1820 and 1858 in Urussanga and Palhoça (Rosario 1996). Afterwards, there were no further records, and the species was considered virtually extinct in Santa Catarina (Rosario 1996,Naka & Rodrigues 2000). Recent and occasional records of the species in the north of the state (Wasilewski *et al.* 2008) led it to be included in the list of threatened fauna of Santa Catarina in the category "critically endangered" (Consema 2011).

In Babitonga Bay, on the north coast of Santa Catarina, field work directed to the study of waterbirds was conducted between 2005 and 2009, but the species was never recorded (Cremer & Grose 2010). An interesting historical record made by Henderson (1821) indicates that the species was abundant in the region: "The whole of these rivers generally run tamely between low banks, of marshy nature, abounding with considerable number of the beautiful scarlet guara bird, which delight the eye of navigators."

Research involving breeding aspects of the Scarlet Ibis in mangrove areas in Brazil was carried out at a breeding colony on Cajual Island, Maranhão State (Rodrigues 1995; Hass *et al.*1999; Martinez & Rodrigues 1999), and in great detail in the mangroves of Santos-Cubatão, in São

Paulo State (Olmos & Silva and Silva 2001, 2003, Olmos 2003, Silva and Silva 2007). Both colonies suffered from the pressures of poaching, collecting of eggs and chicks and habitat degradation. This human interference can put in danger the reproduction of the species, leading adults to change or abandon the colony (Rodrigues 1995, Hass *et al.* 1999, Martinez & Rodrigues 1999, Olmos & Silva and Silva 2003, Gonçalves *et al.* 2010).

Here we describe the first breeding event of the Scarlet Ibis in southern Brazil after a long period of local extinction. More precisely, breeding records were made on Jarivatuba Island, in the Babitonga Bay estuary, northern Santa Catarina State.

METHODS

Study Area

Jarivatuba Island (26°29'66.45"S and 48°79'58.14"W) is near the mouth of the Cachoeira River, and near Joinville city (Figure 1), in Babitonga Bay. The island has an area of approximately 136,645 m² and was recently formed by the growth of mangrove trees. There is no human settlement on the island, probably due to the muddy and unconsolidated soil. The mangrove forest in this region is mainly composed of black mangrove (*Avicennia shaueriana*) and white mangrove (*Laguncularia racemosa*) (Ibama 1998, Dornelles *et al.* 2006). The salinity of the surface water in the vicinity of the breeding colony varies from 17 to 22 ‰ (Oliveira *et al.* 2006). Nearby there is a large foundry as well as the Joinville Yacht Club and small marinas. The island is situated next to a navigation channel that leads to the marinas in Joinville city.

The Babitonga Bay estuary has an area of 160 km². It is surrounded by the cities of São Francisco do Sul, Araquari, Barra do Sul, Itapoá, Garuva and Joinville. The climate is characterized as super-humid, according to the Thornthwaite classification (Gaplan 1986), and the average annual rainfall is around 2.265 mm (Gonçalves *et al.* 2006). High tide is about 2 m during spring season (Cremer 2006).

The largest bird colony in Babitonga Bay is located in Jarivatuba Island (Fink 2013). Besides the Scarlet Ibis, five species of Ardeidae breed in the area (Black-crowned Night-heron, *Nycticorax nycticorax;* Yellow-crowned Night-heron, *Nyctanassa violacea*; Cattle Egret, *Bubulcus ibis;* Snowy Egret, *Egretha thula*; and Little Blue Heron, *E. caerulea*), and one species of the family Threskiornithidae, the White-faced Ibis, *Plegladis chihi*.

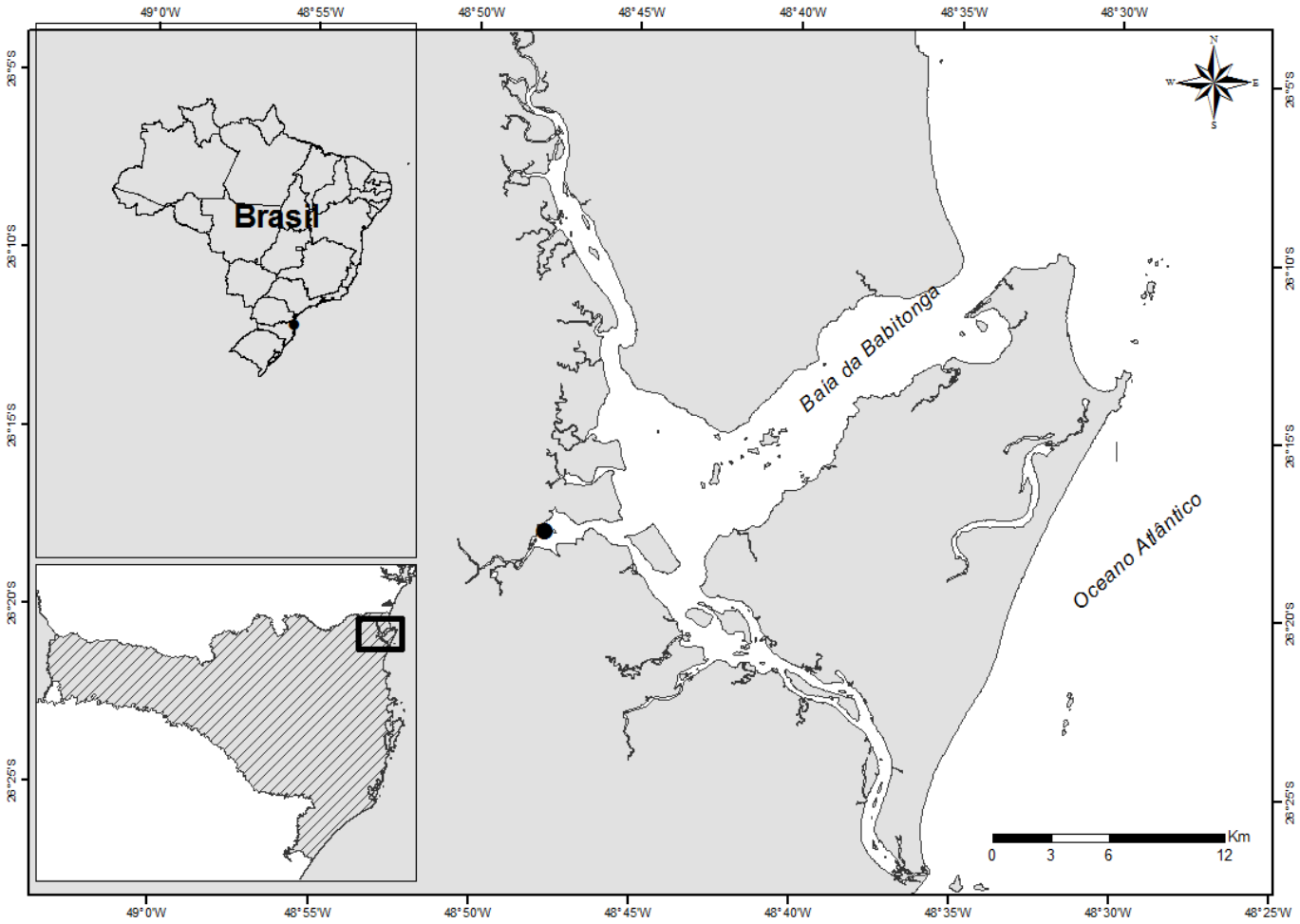

FIGURE 1. Localization of Jarivatuba Island, in Babitonga Bay, Joinville, Santa Catarina State.

Data Collection

Between August 2011 and March 2012, excursions were made fortnightly to Jarivatuba Island to record the waterbirds that nest, rest and feed in the area. Observations were made in a 5,5 m long boat with a 15 or 60 hp outboard motor, always during high tide, when it was possible to cross the channels inside the island. During each survey when reproductive groups of the Scarlet Ibis were sighted, their geographic positions were recorded, along with the number of adults, nests and chicks, besides behavioral information and physical characteristics related to the reproductive period (Olmos & Silva and Silva 2003). Binoculars 8x42 were used during observations.

Since this is a wary bird (Rodrigues 1995, Sick 1997), which responds quickly to any type of disturbance (Olmos & Silva and Silva 2003), and considering that this was the first reproductive event of the species at this site, we decided not to perform any type of interference other than observing (*e.g.*, tagging or collecting biological samples). The observations were conducted no closer than 5 m from the nests.

RESULTS

Eighteen surveys were done in the breeding colony of Jarivatuba Island. The Scarlet Ibis was present in 11 surveys, totaling 25 hours of direct observations of the species.

The first Scarlet Ibis was recorded at the site on November 4, 2011. It was an adult flying with a group of White-faced Ibises, a species that was present in the colony since October in reproductive activity (Table 1).

TABLE 1. Date, number of adults and chicks and characteristics of Scarlet ibises recorded on Jarivatuba Island, Joinville, SC.

Date	Number of adults	Number of chicks	Observations
Nov/04/2011	1	0	First adult, flying over the breeding colony with *Plegadis chihi*.
Nov/17/2011	1	0	Adult, flying over the breeding colony with *P. chihi*.
Dec/06/2011	6	0	Adults, flying over the colony.
Dec/13/2011	50	0	Collective flocks of adults, some individuals displaying: opening of wings and cleaning.
Dec/20/2011	30	0	Presence of reproductive characteristics in adults: gular pouch, black bill and intense red feathers.
Jan/05/2012	71	0	Five reproductive nuclei (set of nests). Some adults in incubation position in the nests.
Jan/20/2012	52	0	Chicks with few days of life, showing thin and black fuzz. 28 nests recorded.
Feb/01/2012	52	25	Chicks with fuzz and black claws at the tip of the wings. 26 nests recorded.
Feb/17/2012	26	35	Chicks with gray fuzz and white bellies making small flights.
Mar/06/2012	8	47	Chicks gray with fuzzy white bellies, performing flights with some adults. Chicks aggregated in nurseries.
Mar/20/2012	27	39	Chicks gray with fuzzy white bellies fliying with some adults. Chicks aggregated in nurseries.

Scarlet ibises selected the site for reproduction in early December, when many adults formed collective flocks in the colony. The birds established the colony in late December, after the end of the reproductive cycle of the White-faced Ibis. The Scarlet Ibis had only one breeding pulse. When recorded for the first time, this species already had bright red plumage and a black beak, a typical reproductive characteristic (Olmos & Silva and Silva 2003).

Five Scarlet Ibis reproductive nuclei (set of nests) were recorded on Jarivatuba Island; four were located in the central region of the island and one on the edge (Figure 2). Two other nests were built individually. The nests were built very close to each other, ranging from 5 to 12 nests per nucleus. They were build with wood sticks, irregularly arranged and shaped like a coarse bowl (Figure 3). Most nests were about 4 m above the ground. In this period the chicks hardly moved, had black feathers, and a very thin and orange beak, with black spots. It was not possible to count each chick individually, because we kept a safe distance to avoid stressing the adults, making it difficult to see the chicks. Eleven days later (Figure 4), the chicks could move out the nest and reach nearby branches.

FIGURE 2. Jarivatuba Island, in Babitonga Bay, Joinville, Santa Catarina State. The white circles represent the Scarlet Ibis reproductive nuclei. Source: Google Earth.

FIGURE 3. Nest of Scarlet Ibis about one week old, on Jarivatuba Island, Babitonga Bay. Photo: D. Fink.

FIGURE 4. Scarlet Ibis chick about three weeks old, on Jarivatuba Island, Babitonga Bay. Photo: D. Fink.

The last survey was made on April 18, when 14 juveniles were observed foraging along the Cachoeira River, in pairs or alone. A group of 36 adults remained on Jarivatuba Island, but reproductive activity was no longer recorded in the area. Only one chick was foraging in the tidal flat, together with a group of adults.

During the surveys, seven species of potential predators of bird eggs or chicks were recorded flying over the colony: Turkey Vulture (*Catarthes aura*), Black Vulture (*Coragyps atratus*), Great Black Hawk (*Urubitinga urubitinga*), Roadside Hawk (*Rupornis magnirostris*), Southern Caracara (*Caracara plancus*), Yellow-headed Caracara (*Milvago chimachima*), and Kelp Gull (*Larus dominicanus*). However, only one predation event was recorded. On January 20, a Great Black Hawk attacked a Scarlet Ibis chick in the nest. This nest was located in the only reproductive nucleus at the edge of the colony. After this event, no more adult Scarlet ibises were recorded at this nucleus.

DISCUSSION

There was a gap of about 150 years in the occurrence of the Scarlet Ibis in Santa Catarina, and the species was considered extinct in the state (Rosario 1996; Naka & Rodrigues 2000). The records of Scarlet Ibis in Santa Catarina were only historical, dating back to the eighteenth and nineteenth centuries (Rosario 1996). Thus, no scientific or technical information about the species in the region existed until now. James Henderson, who wrote about his trip to Brazil (Henderson 1821), described a large number of scarlet ibises in Babitonga Bay. However, it is unknown why the species became extinct in the region. Recently, Wasilewski *et al.* (2008) reported two Scarlet ibises in Santa Catarina in a personal communication and without geographic coordinates: one in Babitonga Bay, without specifying the year, and one in São Francisco do Sul Bay in 2007. We believe that this second record is related to the Palmital River region, referred to in some maps of Babitonga Bay as São Francisco do Sul Bay.

There are reports of young individuals in the neighboring state of Parana, but so far, a Scarlet Ibis breeding colony has not been recorded in this region; the last Scarlet Ibis record in this area was in 1820 (Olmos & Silva and Silva 2003).

The displacement of the Scarlet Ibis from Santos-Cubatão to the Cananéia - Iguape - Ilha Comprida region, where they formed new breeding colonies, was

confirmed through the capture and tagging of some individuals (Paludo *et al.* 2005, Silva and Silva 2007). The distance between the two aforementioned sites is 140 km in a straight line (Silva and Silva 2007). The most likely hypothesis for the origin of the Scarlet ibises that reproduce in Babitonga Bay is that the individuals came from Ilha Comprida, São Paulo State, the nearest known colony. In this case, Scarlet Ibis individuals traveled about 200 km in a straight line.

The breeding colony of Jarivatuba Island is the largest in Babitonga Bay, considering the number of species and individuals (Fink 2013). Besides the Scarlet Ibis, six other waterbird species nested in this colony. This could explain why the species chose this area first for reproduction in the region. A large breeding colony represents security, and a mixed colony apparently is a safe place where other species reproduce (Burger 1981). The island apparently does not suffer any direct anthropogenic disturbance, such as the capture of eggs and chicks or hunting by humans.

This first breeding event of the Scarlet Ibis reported on Jarivatuba Island herein occurred after a period of heavy rains in December, where 314 mm of rain were recorded for 20 days. Some authors suggest that the species starts breeding after being stimulated by heavy rainfall in the rainy season (Rodrigues 1995, Silva and Silva 2007). The rainfall could be related to the availability of some forms of prey, more abundant under these conditions, such as crustaceans, fish and insects (Rodrigues 1995, Sick 1997, Frederick 2002).

Olmos & Silva and Silva (2001, 2003) and Olmos (2003) report that in the Santos-Cubatão mangrove, the Scarlet Ibis can have three reproductive pulses, in November, December and January, being the first species to start breeding activities in the whole waterbird colony. In this area the mean number of breeding pairs was 130 and the last reproductive pulse produced few chicks, due to predation by the Harris Hawk (*Parabuteo unicintus*). Herons and ibises, in general, have two reproductive peaks, referred to as a bimodal pattern. In this case, the second peak generally accommodates pairs that were unsuccessful in the first breeding pulse and also migrants who arrived later (Rodgers 1980). In Babitonga Bay, the Scarlet Ibis was the last species to reproduce. These individuals could be latecomers, arriving from other breeding colonies, and this could cause a delay in their beginning of reproductive activities and the occurrence of only one reproductive pulse. Colonial birds that nest later tend to have less reproductive success, a phenomenon known as late breeder, which often occurs with young or inexperienced individuals (Rodgers 1980, Olmos & Silva and Silva 2003). Another possibility is that these individuals were mature and experienced, and arrived later because they had their nests destroyed in another breeding colony.

Seven species of potential bird predators were recorded on Jarivatuba Island, but the only event of predation recorded involved a Black Hawk. In Santos-Cubatão, predation of chicks has been observed by the Harris Hawk, the main predator at this site, and peregrine falcons (*Falco peregrinus*). Predation by mammals such as the Crab-eating Raccoon (*Procyon cancrivorus*), the Lesser Grison (*Galictis cuja*), the Crab-eating Fox (*Cerdocyon thous*) and the Black Rat (*Rattus norvegicus*) or reptiles such as the Broad-snouted Caiman (*Caiman longirostris*) were recorded in breeding colonies (Olmos & Silva and Silva 2003), but were not detected in our study. It is probable that Jarivatuba Island is more protected from terrestrial predators because it is an isolated mangrove area.

People access Jarivatuba Island with boats only during high tide, which can cause some disturbance in the area. Although artisanal fishermen fish around the island, there has been no report of any situation of vandalism in this breeding colony. However, the region that surrounds the colony is very urbanized and industrialized, including a large foundry nearby. These factors could cause the Scarlet Ibis to move away and change location for breeding in the future (Hass 1999, Olmos & Silva and Silva 2003).

The city of Joinville has only 14% of domestic sewage treated. Much of the untreated domestic and industrial effluents are dumped into Babitonga Bay through the Cachoeira River (Oliveira *et al.* 2006). Moreover, Joinville is the largest industrial city in Santa Catarina State and industrial effluents without proper treatment can cause contamination by trace elements and organochlorine compounds, especially for species at the top of the food chain, such as waterbirds (Fink 2013).

At one edge of the island is the navigation channel to the Cachoeira River, where many marines are installed. The mangrove trees on this edge suffer serious impact due to motorboat traffic at high speed, which leads to soil erosion and consequently the toppling of trees. One solution to reduce this impact could be the establishment of navigation rules in the area, such as speed limits for vessels.

Babitonga Bay is home to many species of birds, resident and migratory, which use the site for feeding, resting and reproduction (Cremer & Grose 2010, Cremer *et al.* 2011). Furthermore, the region is considered an "Important Area for Conservation of Birds" due to the presence of endangered species (Bencke *et al.* 2006). Thus, the presence of an endangered species, such as the Scarlet Ibis, which is "critically endangered" in Santa Catarina State, deserves special attention by the government, and the creation of a protected area would be a long-term strategy for the conservation of this species and its ecosystem. Continued research on the colony would be very important to determine if the species will stay in this area.

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