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ARTIGO

Evaluation of the status of conservation of the Cabot's Tern *(Thalasseus acuflavidus)* in Brazil

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RESUMO: Avaliação do estado de conservação do trinta-réis-de-bando *(Thalasseus acuflavidus)* no Brasil. O trinta-réis-de-bando, *Thalasseus acuflavidus* é considerado uma das mais vulneráveis espécies costeiras do Brasil. Sua distribuição está limitada ao Caribe, costa atlântica da América do Norte e América do Sul. No Brasil, seus ninhos em pequenas ilhas costeiras estão suscetíveis aos distúrbios humanos. Historicamente suas colônias tem sofrido intensiva coleta de ovos por parte de pescadores, o que contribui severamente com o decréscimo de seu sucesso reprodutivo. A população brasileira está confinada principalmente na costa do Espírito Santo. Este artigo avalia o estado de conservação da população de *T. acuflavidus* no Brasil e discute sua categorização. Nossa avaliação do estado de conservação desta espécie segue os critérios e categorias adotados pela IUCN. Aqui nós revisamos vários parâmetros incluindo o nível taxonômico, as principais ameaças, as áreas de extensão e ocorrência e o tamanho atual da população. Uma vez que o Trinta-réis-de-bando vem perdendo áreas de reprodução em diversas áreas da costa brasileira, nós recomendamos que esta espécie seja considerada como "Vulnerável" no nível nacional. Ele também pode ser considerado "Em Perigo" em nível estadual. Finalmente, nós sugerimos que esforços de pesquisa e conservação sejam ampliados na costa do Espírito Santo e que ações de conservação semelhantes sejam implementadas ao longo da costa brasileira.

PALAVRAS-CHAVE: Trinta-réis-de-bando; *Thalasseus acuflavidus;* Estado de conservação; Brasil; Ave marinha; Critérios da IUCN.

ABSTRACT: Evaluation of the status of conservation of the Cabot's Tern *(Thalasseus acuflavidus)* in Brazil. The Cabot's Tern, *Thalasseus acuflavidus* is considered to be one of the most vulnerable coastal species in Brazil. Its range is limited to the Caribbean and Atlantic coasts of North and South America. In Brazil it nests on small coastal islands that are susceptible to human disturbance. Historically, its colonies have suffered extensive egg collection by fishermen, which has severely decreased its reproductive success. The Brazilian population is mainly confined to the coast of Espírito Santo state. This paper evaluates the population status of *T. acuflavidus* in Brazil and discusses its threat category. Our evaluation of the conservation status of this species follows the criteria and categories adopted by the IUCN. Here, we review several parameters, including taxonomic level, principal threats, area and extent of occurrence, and current population size. Because Cabot's Terns have recently been extirpated from other areas of the Brazilian coast, we recommend that this species should be defined as Vulnerable at the national level. It may also qualify as Endangered at the state level. Finally, we suggest that research and conservation efforts should be increased on Espírito Santo coast, and that conservation actions should be implemented across the whole Brazilian coast.

KEY-WORDS: Cabot's Tern; Conservation status; Brazil; Seabird; IUCN criteria; *Thalasseus acuflavidus.*

The ornithological literature contains scarce information on Cabot's Tern (Junge and Voous 1955). One of the remaining taxonomic uncertainties in the Sternini was the classification of the species complex of the Sandwich/Cabot's/Cayenne tern (Efe *et al.* 2004). Within this complex, there are three forms classified either as subspecies or species: Sandwich tern *(T. s. sandvicensis)* that breeds on the Atlantic and Mediterranean coasts of Europe, Cabot's tern *(T. s. acuflavidus)* breeding on the Atlantic coasts of North America and the Caribbean, and Cayenne tern *(T. s. eurygnathus)* that breeds on the Atlantic coast of South America from Argentina north to the Caribbean. A recent mtDNA analysis of this species complex (Efe *et al.* 2009) has helped to the phylogenetic relationships of the group.

Cabot's Tern (now *Thalasseus acuflavidus;* Efe *et al.* 2009) breeds on the Caribbean and Atlantic coasts of North and South America. Its range extends from the southern USA, Caribbean along the coasts of Colombia, Venezuela, Surinam, Brazil, and Uruguay south to Argentina as far as Puerto Deseado (Escalante 1973, Shealer 1999).

Antas (1991) identified the Cabot's Tern as the most vulnerable coastal species in Brazil, due to extensive egg collection by fishermen. Since then, this species has been

the focus of studies and conservation initiatives. The Andorinhas do Mar Project curtailed egg collection in Espírito Santo State, mainly through protection and education (Efe *et al.* 2000); however, the long-term survival of the Cabot's Tern remains uncertain. In the nearshore zone of South Carolina it is subjected to anthropogenic disturbances including development pressure and recreation, natural disturbances such as frequent hurricane and other biotic factors such as predation, parasitism, or food availability may affect population dynamics as well (Jodice *et al.* 2007, Emslie *et al.* 2009).

Conservation strategies and coordinated management actions at the regional scale require knowledge of tern breeding distribution, the relationships among populations, and of factors affecting them (Yorio and Efe 2008). This paper evaluates the conservation status of *T. acuflavidus* in Brazil and discusses its current threat level.

METHODS

Our evaluation of the conservation status of the Cabot's Tern follows the criteria and categories established by the IUCN (IUCN 2008). The IUCN categories and criteria are defined for the global evaluation of a taxon. However, these definitions can also be appropriate for regional use (Gärdenfors *et al.* 2001). In this paper we review information on the conservation status, including taxonomic level, main threats, area and extent of occurrence, and current population size in Brazil and follow Gärdenfors *et al.* (2001) for the evaluation at the national and regional level.

Likewise the Brazilian Ornithological Committee (CBRO 2010), we treat *T. acuflavidus* as a valid specie, following Efe *et al.* (2009), who showed, using a molecular phylogenetic analysis, that European and American *T. "sandvicensis"* are distinct species and proposed the treatment of the American *acuflavidus/eurygnathus* complex as Cabot's Tern, *Thalasseus acuflavidus.*

According to Birdlife International (2001), the extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. For the estimate of the extent of occurrence in this analysis we used the following reasoning: coastal breeders usually forage from tidal creeks and estuaries to ocean waters, usually close inshore, but occasionally ranging across the continental shelf (Gochfeld and Burger 1996). Since studies shown that other terns can be found until 25 km offshore (Pearson 1968, Veen 1977, Bugoni and Vooren 2004), we considered this distance for the estimate of the extent of occurrence of the Cabot's Tern in Brazil.

Area of occupancy is the area inside the extent of occurrence which is occupied by a taxon, excluding cases of vagrancy. This category reflects the fact that a taxon will not usually occur throughout its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon (BirdLife International 2001). For the estimate of the area of occupancy in this analysis we used the following reasoning: according to Shealer (1999) most breeding birds forage at a maximum distance of 15-25 km from their breeding sites (mean value of 20 km). Bugoni and Vooren (2005) showed that Common Tern on their wintering ground in southern Brazil fed over water 10-20 m in depth, within 8 km of the coast. Therefore, we consider the area of occupancy of the Cabot's Tern in Brazil to be a circular area around the breeding sites 20 km in radius (*e.g.,* area of 1,256 km^2) and the feeding area a distance of 8 km from the shore.

Following the recommendations of Gärdenfors *et al.* (2001) for the evaluation Red List Criteria at the national and regional level, we analyzed: (1) contact of the national population with the neighboring populations, (2) dispersal capacity of the species, (3) abundance of and threats to the species in the neighboring populations, (4) differences in local adaptation between the national and neighboring populations, (5) the environmental conditions within each country or region and (6) environmental conditions necessary for the immigration and recolonization of the species, within 100 years, should it be extirpated at the country level.

RESULTS AND DISCUSSION

Using the above definition, the Cabot's Tern is distributed all along the Brazilian coast (~ 6.100 km). We estimate the extent of occurrence as the area contained within the imaginary boundary of 6,100 km long and 25 km wide or approximately 125,500 km^2. However, this area is not completely occupied by the Cabot's Tern. A review of the historical nesting records indicates that Cabot's Terns have bred in at least 16 different breeding sites in Brazil (Table 1) and have been reported in four foraging areas (Figure 1) during the non-breeding period. The area of occupancy of the 20 suitable areas with appropriate nesting and foraging habitat was estimated for the 16 breeding sites to be 20,096 km^2 and 6,257 km^2 for the four foraging sites (Mangue Seco beach with 240 km^2; Coroa Vermelha island with 201 km^2; Coast of Paraná with 856 km^2 and Rio Grande do Sul's coast 4,960 km^2).

Both the estimated extent of occurrence and area of occupancy are larger than the necessary limits for inclusion in the criteria for Critically Endangered, Endangered or Vulnerable.

Contact with the Neighboring Populations

The extent of possible hybridization between North and South American Cabot's Tern specimens has been documented quantitatively (see Hayes 2004) and the migration between nearby colonies has been demonstrated (Shealer 1999, Efe *et al.* 2000). Efe *et al.* (unpublished data) show that high gene flow occurs between the Brazilian and North American populations, demonstrating the contact of the Brazilian population with more northern populations. The South American populations are in close contact in some localities in Brazil (*e.g.,* Lagoa do Peixe, RS) used by both populations as a foraging site (Efe *et al.* 2000, Bugoni and Vooren 2004) and individuals banded in Brazil have been captured in foraging sites at Argentina and Uruguay and vice-versa (Efe *et al.* 2000). Nevertheless, Efe *et al.* (unpublished data) showed that lower gene flow occurred between the Brazilian and Argentinean populations. The difference in breeding season phenology (summer in Argentina, winter-spring in Brazil) could explain this low level of gene flow between these two populations despite their geographical closeness.

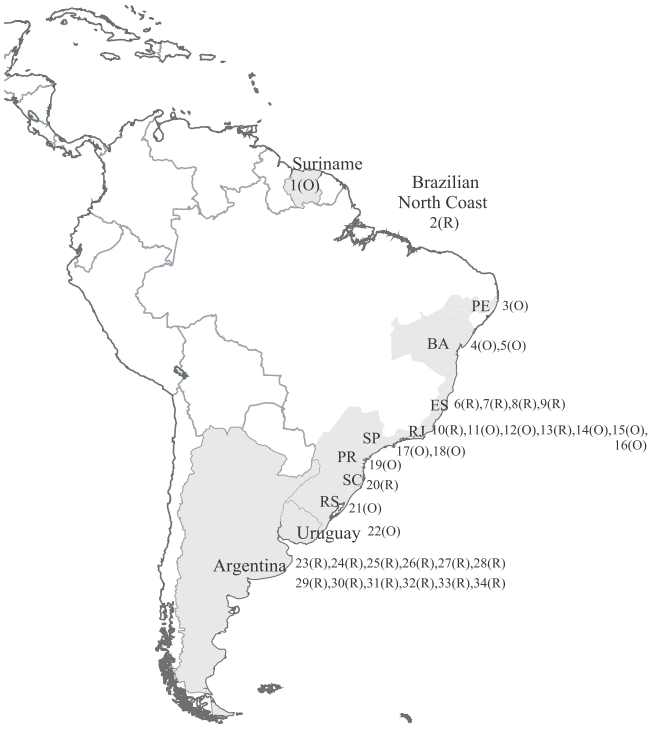

FIGURE 1: Records of *T. acuflavidus* in South American Atlantic coast. Adapted from Efe *et al.* (2000), sources in Efe *et al.* (2000) and Table 1. Status: O = occurrence and important feeding areas, R = breeding areas. Localities: 1 = Mangue Seco beach; 2 = Coroa Vermelha island; 3 = Pacotes island; 4 = Itatiaia Archipelago; 5 = Escalvada island; 6 = Branca island; 7 = Papagaios island; 8 = Rio-Niteroi Bridge, 9 = Casa da Pedra island; 10 = Prainha island; 11 = Apara island; 12 = Laje de Santos island; 13 = Castilho island; 14 = Figueira island; 15 = Itacolomis island; 16 = Coast of Paraná; 17 = Deserta island; 18 = Moleques do Sul island; 19 = Cardos island; 20 = Coast of Rio Grande do Sul (Bugoni e Vooren, 2005).
Note: NC: not assessed; 1 = Efe *et al.* (2000); 2 = Antas (1991); 3 = Alves *et al.* (2004); 4 = Campos *et al.* (2004); 5 = Olmos *et al.* (1995); 6 = Krull (2004); 7 = Branco (2003).

Dispersal Capacity of the Species

Most terns are migratory and some tropical species, including some Cabot's Tern populations, move great distances during the non-breeding period (Gochfeld and Burger 1996). Brazilian Cabot's Terns show post-breeding dispersal, moving along the northeastern coast of Brazil and southern coast of South America, including Argentina as far south as Peninsula Valdez (Efe unpublished data), showing an excellent capacity for long-distance dispersal.

Abundance and Threats in the Neighboring Populations

The total worldwide population of Cabot's Tern may be less than 80,000 pairs. The North American population is estimated in about 47,000 pairs (Shealer 1999); the Caribbean one at about 8,000 pairs (Norton 1984); 1,700-3,470 pairs in Aruba; 1,200 pairs in Guiana (data compiled by Shealer 1999); and about 10,000 pairs in Argentina (Yorio and Efe 2008).

Egg collection and disturbance at breeding sites are considered the main factors limiting reproductive success of Cabot's terns (Gochfeld and Burger 1996, Shealer 1999). Other threats to the species include predation by gulls, exploitation of fisheries, and introduced predators (Gochfeld and Burger 1996). On Punta León (Argentina), Kelp Gulls *(Larus dominicanus),* whose population has soared because of increased food supplies from fisheries and garbage dumps, were the main predators of Royal *(Thalasseus maximus)* and Cabot's Tern eggs, decreasing their reproductive success in all colonies studied (Quintana and Yorio 1997).

Differences in Local Adaptation between the National and Neighboring Populations

Ecological variability is common in Cabot's Tern, indicating there are differences among different geographic. In the U.S. and Gulf coasts, they typically nest on low, sandy, flat islands close to shore (Oberholser 1974, Visser and Peterson 1994). In the Caribbean region they breed on low-lying islands situated in extensive saline lagoons, on bare coral rocks, on patches of coral debris and sand and on elevated rocks covered with thorny scrub and opuntia cacti. The breeding grounds in Brazil have low shrub vegetation, predominantly cacti (Efe *et al.* 2000). In Argentina, colonies are characterized by extensive cliffs

TABLE 1: The location and size (in breeding pairs) of Cabot's Tern colonies in coastal Brazil. All locations where terns have bred in the past are listed.

Number in Map (Figure 1)	State	Site	Location	Size (nº nests)	Year	Source
3	Espírito Santo	Pacotes Is.	20°21'S, 40°16'W	NC	1994	1
4		Escalvada Is.	20°42'S, 40°24'W	6500	1996	1
5		Itatiaia Is.	20°21'S, 40°17'W	1500	1996	1
6		Branca Is.	21°00'S, 40°47'W	5000	1990	1
7	Rio de Janeiro	Papagaios Is.	22°24'S, 41°48'W	NC	1981	2
8		Rio-Niteroi Bridge	22°52'S, 43°10'W	66	2001	3
9		Casa da Pedra Is.	22°47'S, 43°08'W	NC		3
10	São Paulo	Prainha Is.	23°51'S, 45°25'W	75	U	4
11		Apara Is.	23°50'S, 45°33'W	25	U	4
12		Laje de Santos Is.	24°19'S, 46°11'W	142	U	4
13		Castilho Is.	25°17'S, 47°57'W	40		5
14		Figueira Is.	23°55'S, 45°18'W	NC	1985	2
15	Paraná	Itacolomis Is.	25°50'S, 48°24'W	100	1995	6
17	Santa Catarina	Deserta Is.	27°16'S, 48°20'W	65	1999	7
18		Moleques do Sul Is.	27°51'S, 48°26'W	200	2000	7
19		Cardos Is.	27°48'S, 48°34'W	76	2002	7

30-100 m high and gravel beaches along the shoreline (Yorio *et al.* 1998).

In the U.S., Cabot's Tern usually nests in dense groups among Royal Terns *(T. maximus),* Laughing Gulls *(Larus atricilla),* and sometimes Black Skimmers *(Rynchops niger)* (Shealer 1999). In the Caribbean, they nest with Royal (McGinnis and Emslie 2001, Hayes 2004) and Roseate Terns *(S. dougallii).* Along the Brazilian coast, nesting occurs in mixed colonies with the South American Tern *(S. hirundinacea)* (Efe *et al.* 2004) and Royal Terns (Campos *et al.* 2004, Rosa de Campos *et al.* 2007). In Argentina Cabot's Terns nest in mixed colonies with Kelp Gulls and Royal Terns (Quintana and Yorio 1997).

Breeding phenology differs among regions; in most U.S. and Caribbean colonies the first adults arrive in late April or early May (Shealer, 1999.) The terns in Brazilian colonies begin to arrive in mid-April and the settlement at the colony site occurs from May onwards. In mid-September birds begin to leave the colonies and after the end of October they are rarely found on the coast (Campos *et al.* 2004, Efe 2004, Fracasso *et al.* 2010). In Argentina, Cabot's Terns start to arrive in mid-September (Quintana and Yorio 1997) and nesting has been record until January (Escalante 1970).

Environmental Conditions within Brazil

The Brazilian coast has suffered severe environmental degradation in recent decades. Coastal islands are particularly vulnerable to degradation since they are used by both fishermen and tourists visiting from the mainland. In some areas, weather and predation limit the reproductive success of Cabot's Terns. Here, we summarize the primary threats affecting each of the main nesting areas along the Brazilian coast.

A recent analysis found that on the islands of Espírito Santo, storms are the most common cause of mortality (Efe *et al.* 2005). The Rio de Janeiro islands colonies are also disturbed by humans and, the eggs and chicks being taken by both native (Black Vulture, *Coragyps atratus* and *Larus dominicanus*) and introduced predators (cats and mice). Cabot's Terns have used the pillars of the Rio-Niterói Bridge for breeding (Alves *et al.* 2004). On the São Paulo coast, Cabot's and other tern species are threatened due to disturbance in nesting colonies and roosting sites. Egg collection, fire and intense human presence on the beaches and at sea increase the susceptibility of these colonies (Campos *et al.* 2004). On the Paraná coast, as elsewhere, Cabot's Terns feed on fish discarded by fishermen, but their nesting colonies are often disturbed by fishermen and tourists (Krull 2004). On Deserta island (27°16'23"S, 48°19'53"W – part of the Federal Biological Reserve), on the Santa Catarina coast, the main threat to Cabot's Terns is predation by Kelp Gulls (Branco 2003). Kelp Gull predation on eggs and nestlings is well-known in June and July on Deserta island, and has forced birds to abandon the colony (Branco 2004).

Kelp Gulls are widely distributed in the Southern Hemisphere, breeding in South America, southern Africa, Australia, New Zealand, on sub-Antarctic islands, and on the Antarctic Peninsula (Burger and Gochfeld 1996). In Brazil, Kelp Gulls breed from the coast of Santa Catarina north to the coast of Rio de Janeiro, rarely reaching the Espírito Santo coast. In fact, the absence of Kelp Gulls, in addition to conservation activities and abundant food, is considered the reason for the high reproductive success of colonies on the Espírito Santo coast.

It is important to evaluate the potential of the national population to be self-sustaining or if it dependents

on immigration for its long-term survival. However, during the past 20 years, only a few studies have been conducted on important topics such as basic reproductive biology and population dynamics of this species (Shealer 1999). A study from 1993 to 1997 showed an annual population growth of 1.051% and an intrinsic rate of population growth of 0.199 in Escalvada island, in Brazil (Efe *et al.* 2005), suggesting the population has a low capacity to sustain itself and is dependent on immigration of birds from elsewhere.

Environmental Conditions Necessary for the Immigration and Recolonization of the Species

The distribution of Cabot's Tern in Brazil was poorly known until 1963, when breeding colonies were first located (Sick and Leão 1965). Cabot's Terns have a limited breeding distribution restricted to small coastal islands that are vulnerable to unpredictable environmental conditions. The breeding distribution of the Cabot's Tern is highly fragmented in some areas, and the species is known to breed in less than ten localities with populations over 100 pairs (see Yorio and Efe 2008). Continuing declines have been documented in the quality of nesting and foraging habitats, the total area of occupancy, and the total number of locations or subpopulations are reasons for concern.

The majority of the Brazilian population is restricted to the Espírito Santo coast, nesting on the islands of Escalvada, Itatiaia, and Branca (Table 1). In addition, several smaller colonies exist that are used by different subpopulations; population estimates of these colonies rarely exceed a few hundred individuals. From the six islands that Cabot's Terns nest on the Espírito Santo coast (500 km), four are protected by the Andorinhas do Mar Project; however, reproductive success has been low on two of them for several years. On the Rio de Janeiro (635 km), São Paulo (390 km), Paraná (107 km), and Santa Catarina coasts (670 km), small breeding colonies are threatened by human intervention and by Kelp Gull predation – but not in Laje de Santos State Park, now effectively protected. Cabot's Terns feed in areas that are heavily used by fishermen which diminish the supply of food for birds (Barbieri and Pinna 2007) and contaminated by marine pollutants. All these factors make it difficult to maintain the necessary prerequisites for the establishment of immigrants' in the available areas in the country.

Evaluation and Suggested Status

Comparing the status of Brazilian Cabbot's Tern populations with other taxa, the estimated population of the Elegant Tern *(T. elegans)* is between 51,000 and 90,000 individuals; 95% of these breed on Isla Rasa in the Gulf of California, and small populations breed on other islands. IUCN classifies this species as Near Threatened, and population fluctuations are considerably less than one order of magnitude (BirdLife International 2008). The total population of Damara Tern *(Sterna balaenarum)* (Near Threatened) was estimated at 14,000 birds, and its breeding colonies suffer considerable human disturbance (BirdLife International 2008).

The population of Sandwich Terns *(T. sandvicensis)* in Great Britain is 14,000 pairs with an additional 4,400 pairs in Ireland (Ratcliffe *et al.* 2000). The continental European breeding population is between 82,000 and 130,000 pairs, and underwent a moderate decline between 1970-1990 (BirdLife International 2004). The Joint Nature Conservation Committee (JNCC), UK Government's wildlife adviser considers the conservation status of *T. sandvicensis* to be precarious, and recommends general protection of breeding grounds. The IUCN currently classifies this species as of Least Concern; however IUCN includes the data from the American populations, which now must be transferred to *T. acuflavidus* (Efe *et al.* 2009).

Although the estimated extent of occurrence and area of occupancy in Brazil are larger than the necessary limits for inclusion in the IUCN categories of Critically Endangered, Endangered or Vulnerable, the negative populations trends (the estimated population around is 16,000 individuals), and the recent extirpation of the Cabot's Tern in several areas of the Brazilian coast, all suggest that the Brazilian population may be in greater danger in the future. For these reasons we suggested that Cabot's Tern does merit classification in category VULNERABLE at the national level and may qualify as ENDANGERED at the state level.

Regional lists of conservation status directly reflect the status of local populations, and can be used to suggest necessary conservation measures for specific situations (Lins *et al.* 1997). Therefore, we suggest that conservation efforts be increased in the research and conservation programs in Espírito Santo coast, and that conservation actions should be implemented across the entire Brazilian coast.

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