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Aerial census of Cape Cormorants and Cape Fur Seals at Baía dos Tigres, Angola

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ABSTRACT

A total of 250,786 Cape Cormorants, of which 16,038 were individuals on nests in 349 colonies, and 15,831 Cape Fur Seals were counted during a complete aerial photographic census of the island of Tigres and part of the adjacent coast in Angola in March 2017. Such a concentration of birds and seals and the large number of breeding Cape Cormorants highlights the need to protect Tigres and its rich surrounding waters.

Um total de 250.786 Corvo-marinhas do Cabo, dos quais 16.038 eram indivíduos em ninhos em 349 colônias, e 15.831 Leão-marinho-do-Cabo foram contados durante uma pesquisa aérea completa da Ilha dos Tigres e parte do litoral adjacente em Angola em Março 2017. Essa concentração de Corvo-marinhas do Cabo, suas colônias de reprodução e a presença de um grande número de outras aves demonstra a necessidade de proteger Tigres e suas ricas águas circundantes.

Keywords: aerial census; *Arctocephalus pusillus pusillus*; Baía dos Tigres; Cape cormorant; Cape fur seal; *Phalacrocorax capensis*.

INTRODUCTION

Tigres lies in the general boundary area where southern, biologically rich and cold water of the Benguela Current meets warmer, less productive water flowing from the north in the Angola Current. The interface between the two currents is known as the Angola-Benguela Front. The northern Benguela shelf around Tigres supports a considerable biomass of plankton, fish and other marine life (Hutchings et al. 2009). This includes Cape Cormorants (*Phalacrocorax capensis*) and Cape Fur Seals (*Arctocephalus pusillus pusillus*). Both predators feed on fish, are large (and thus easy to count) and are relatively abundant on and around Tigres.

Cape Cormorants are endemic to the coast of South Africa, Namibia and Angola. Their breeding range extends west and north from Algoa Bay in South Africa to southern Angola, but most birds are concentrated where nutrients and biological production is greatest in the Benguela Ecosystem. Cape Cormorants are classified as Endangered by the IUCN, their total population being estimated at about 234,000 individuals (Birdlife 2018). Cape Fur Seals are also endemic to the south-western African coast. The total southern African population of Cape Fur Seals was estimated to be about 2 million in 2004 (Kirkman et al. 2007).

Ilha dos Tigres is relatively remote and extremely flat, conditions which make it difficult to survey animal life from the ground. Five previous surveys provided counts of cormorants and seals in sample areas (Table 1). Breeding colonies of Cape Cormorants and Cape Fur Seals were documented for the first time by Dean et al. (2002) and Dyer (2007).

METHODS

Study Site

Ilha dos Tigres (strictly the island, but generally and better known as Baía dos Tigres) is the only sandy offshore island along the 200 km coast of the Namib Desert in Angola. The island was connected to the mainland prior to 1962. It supported a sizeable town and fish processing industry that disappeared after the connection to the mainland broke. An abundance of fish continues to attract artisanal fishermen from Tômbua, as well as foreign vessels that catch and process fish offshore to the west of Tigres

Table 1: Numbers of Cape Cormorants and Cape Fur Seals counted on and around Tigras prior to 2017 and in this study.

	Simmons et al. (2006) ¹		Dyer (2007) ²	Meÿer (2007) ³	Ministério do Ambiente (2017) ⁴	This study
Survey month and year	January 1999	September 2001	November 2005	December 2006	2017	March 2017
Cape Cormorants	570	>4,000	2,630 pairs		15,248	250,786
Cape Fur Seals			5,167	21,440		15,831

¹ Simmons et al. (2006) is based on a survey along the coast adjacent to Tigras in 1999, and a flight over Tigras in 2001. It is not known how much of the island was surveyed from the air in 2001. The 4,000 Cape Cormorants were associated with about 2,000 nests, this being the first record of breeding in Angola (Dean et al. 2002)

² Dyer (2007) reported 5,167 Cape Fur Seals, of which 1,161 were pups, on Tigras Island. A Cape Cormorant fitted with a radio transmitter and tracked over four months moved (presumably to forage) within a radius of 30 km of Tigras Island. Roux (2007) reported “large numbers at Baía dos Tigras and feeding aggregations of tens of thousands of (Cape Cormorants) were observed in the bay (in August 2005) as during previous years”.

³ Meÿer (2007) reported results from an aerial census covering Tigras Island on 1 December 2006 which produced counts of 17,062 sub-adult and adult Cape Fur Seals and 4,378 pups.

⁴ Ministério do Ambiente (2017) reported a total of 15,248 Cape Cormorants on Tigras Island, and another 3,305 along the coast between Tômbua and Tigras Bay. The date and spatial extent of the survey was not reported.

Data Collection and Analysis

On 1 March 2017 high resolution (4 cm per pixel) aerial photographs were taken from a Jabiru 430 Standard aircraft, with two fuselage-mounted Canon 5Dsr 50 mm focal length cameras, of the entire area of Ilha dos Tigras and part of the adjacent mainland coast (Figure 1). Each image covered about 360 by 206 metres. The survey was conducted in the morning, starting at 07h22 and ending at 10h41 (GMT+1). One of us (JMM) visited Tigras and the adjacent mainland during a low-level reconnaissance flight on 27 February 2017, and then on the ground from 28 February to 2 March 2017. Observations during those visits provided context to results obtained from the aerial photographic census.

A high-resolution monitor was used to search the images for seals and cormorants. Where possible, adjacent images with cormorants and seals were stitched together using Agisoft PhotoScan Professional or Adobe Photoshop.

Cormorants were counted manually on images where few individuals were visible. However, the majority of individuals were clustered in colonies, which we counted using the following procedure.

First, images or sections of images with colonies were imported into Adobe Photoshop. Blocks in which no birds were visible were deleted, while the remaining areas of the image were processed to enhance the contrast between the cormorants and surrounding substrate, as well as the boundary definition between each individual and the substrate and/or other individuals. This was done using combinations of Photoshop’s Contrast, Brightness, Hue, Saturation, Colour Balance and Sharpen tools.

The Eyedropper tool was then used to select all pixels that represented cormorants. The selected pixels were given a distinct, simple colour (bright red or yellow, for example). This process of selection and colour replacement (using the Paint Bucket tool) was

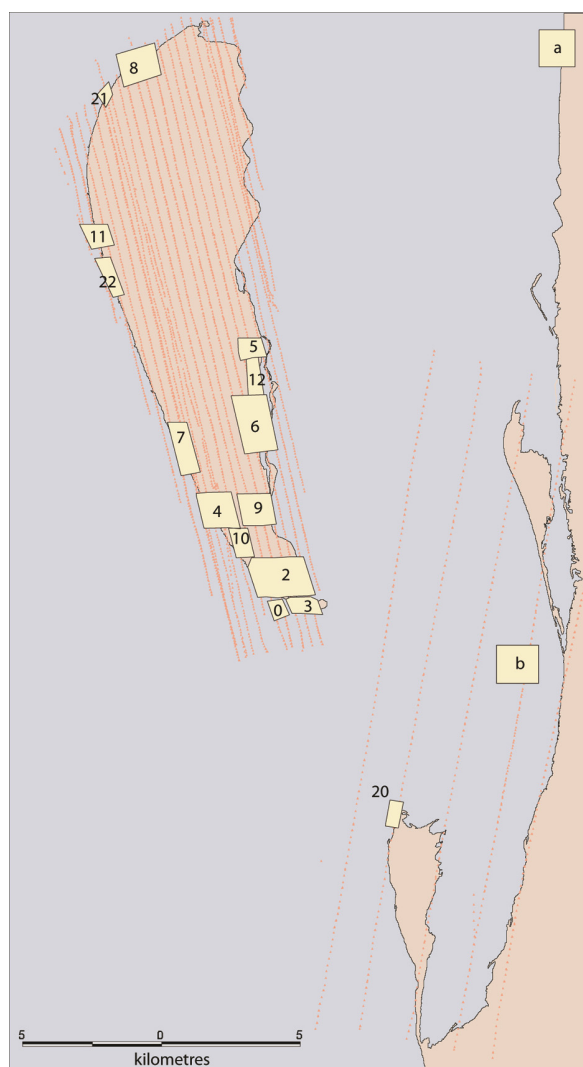


Figure 1: The area of Ilha dos Tigras and the adjacent mainland (which is part of Iona National Park), showing lines of points (red dots) at which aerial photographs were taken. Numbered blocks cover areas where concentrations of Cape Cormorants and Cape Fur Seals were found in the aerial survey photographs, while blocks a and b are locations where the photographs shown in Figure 4 were taken.

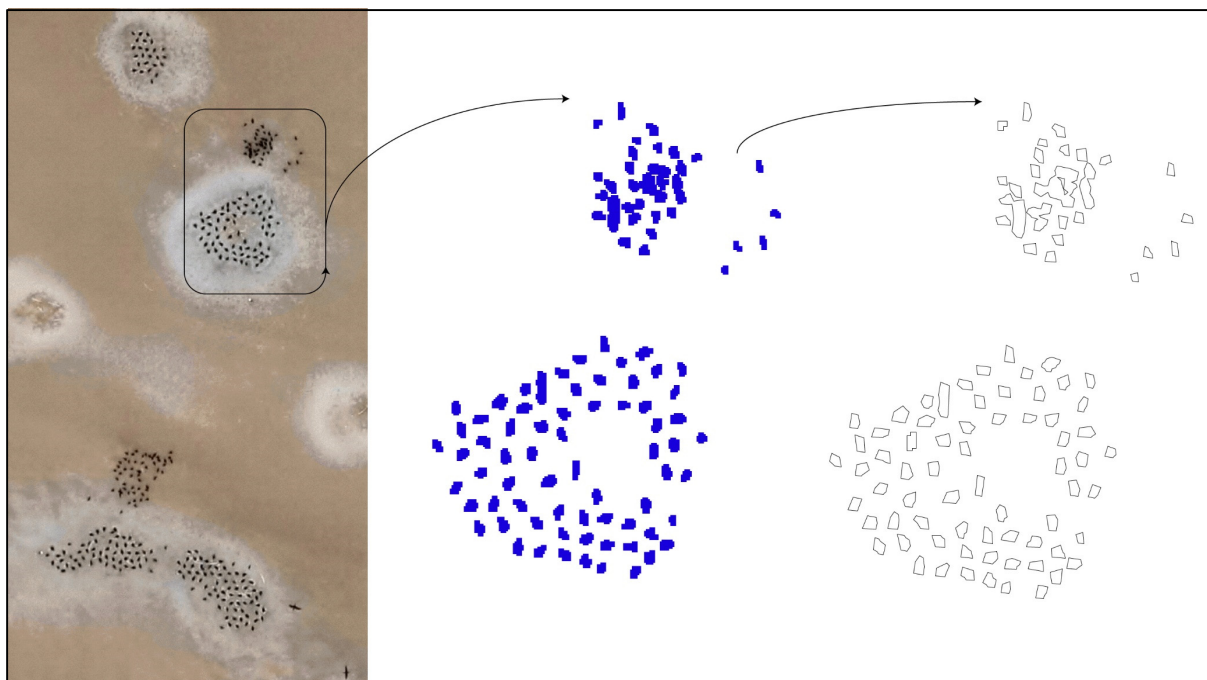


Figure 2: Processing steps used to identify, map and count numbers of nests and individual cormorants in the original photograph (left), the selection of pixels representing cormorants (middle) and the vectorised polygons used to estimate the number of individuals (right). Note the even spacing between nesting birds, while some birds are clustered in the small flock above. Breeding colonies were regarded as separate groups or clusters of nests. For instance, four breeding colonies in areas with pale backgrounds and two non-breeding groups are visible in this image.

repeated until we considered that all pixels representing cormorants had been found and re-coloured.

Some images were rather uniform in colour, such that the substrate was quite similar everywhere, and cormorants in different parts of the image were much the same in colour. Each of those images could be processed in one batch. Other images were more varied, requiring different parts of the images to be processed separately. This was often the case for cormorants close to the image margins which were darker and fuzzier than elsewhere. Most 'background' pixels that did not represent cormorants were deleted from these images.

Second, the images thus processed and re-coloured were imported into ArcView and converted into ArcView grids using its Spatial Analyst extension. Grid cells that had been coloured distinctive reds or yellows were selected and converted into vector polygons. The area covered by each polygon was calculated. The areas were calculated separately for each image because the units of area measurement were usually specific to each image, especially for images that could not be georeferenced (and which thus had arbitrary grid cell dimensions).

While most individual cormorants could be seen, re-coloured, mapped and then counted as separate polygons, colonies often had some clusters in which individuals could not be identified and mapped separately. The size of these groupings and all other

individual polygons were summed and then divided by the average size of a polygon representing a cormorant to estimate the total number of individuals in a colony or image. Average sizes of polygons for individual cormorants were determined from samples of 100 or more polygons that clearly represented individual birds. This process is illustrated in Figure 2.

We attempted to use the same approach to count seals. However, the numbers estimated and physically counted in the images often differed substantially. This was due to the variable sizes of pups, immatures, females and bulls, as well as the great variance in the way in which seals clustered and grouped themselves. Seals were therefore counted individually.

RESULTS AND DISCUSSION

Totals of 250,786 Cape Cormorants (which included 16,038 birds on individual nests) and 15,831 Cape Fur Seals were counted on the aerial photographs. The areas in which most were recorded are shown in numbered blocks in Figure 1, while Table 2 gives the numbers recorded in each of these blocks. Most of the cormorants and seals were recorded on the island of Tigres, but a flock of 16,032 cormorants was found on a peninsula of the adjoining mainland (block 20). The largest single flock numbered about 28,058 cormorants, which formed part of those counted in block 2 (Figure 3).



Figure 3: An estimated 28,058 individual Cape Cormorants roosting in this, the largest single flock photographed on Tigres in March 2017.

Cape Cormorants were found nesting in 349 colonies, each having an average of 46 nests. The nests were evenly spaced across the colony areas (see examples in Figure 2) and assumed to be active because one bird was sitting on each nest. The birds visible could have been adults or well-grown nestlings if the cormorants on Tigres breed at times similar to those in Namibia (October to February – Kemper & Simmons 2015).

Substrates in and around the colonies were paler than their surrounds, presumably coloured that way by accumulations of faecal matter. Numerous other inactive colonies were visible, but we were unable to tell whether they had been used in recent months or longer ago.

Two large flocks of cormorants were recorded in areas beyond those covered by the aerial survey. The first was about 20 km north of the mainland survey zone (Figure 4a). Numbers were not estimated, but certainly thousands of cormorants and hundreds of Kelp Gulls (*Larus dominicanus*) and Great White Pelicans (*Pelecanus onocrotalus*) were present here on the 28th of February 2017 at about 10h30. The second group was encountered at sea but close to the mainland at 12h20 during the aerial reconnaissance flight on the 27th of February. This is marked as block b in Figure 1. From counts of birds in the photograph in Figure 4b and in other photographs, at least 60,000 cormorants were present in this feeding frenzy.

Many more Cape Cormorants were counted during this study than had been previously recorded in the Tigres region (Table 1). Adding the total of 250,786 (Table 2) to the current total population estimate of 234,000 Cape Cormorants (Birdlife 2018) approximately doubles the world population for this

Table 2: Numbers of Cape Cormorants, active nests and Cape Fur Seals counted in aerial photographs taken on 1 March 2017. Block numbers refer to areas shown in Figure 1.

Block	Cape Cormorants		Cape Fur Seals
	Birds	Nests	
0	3,508		
2	64,786	8,310	3,976
3	2,697	3,446	4,570
4	2,697	2,697	1,785
5	9,990		
6	19,430	183	
7	3,372	1,402	
8	14,414		
9	1,429		
10	10,152		
11	128		2,758
12	102,151		
20	16,032		
21			1,010
22			1,732
Total	250,786	16,038	15,831



Figure 4: Flocks of Cape Cormorants, Great White Pelicans and Kelp Gulls at 16.51S, 11.82E recorded on 28 February (marked a in Figure 1) and at 16.72S, 11.81E on 27 February 2017 (marked b in Figure 1).

species. However, the Birdlife figure is double an estimated 117,000 breeding pairs for the species, but does not account for pre-breeding birds and those not participating in breeding. How many non-breeders should be added to Birdlife's estimate of breeding birds is difficult to gauge (J Kemper pers. com. 2017), and we have no idea of the proportion of pre-breeding individuals amongst those photographed in March 2017 on Tigres. Crawford et al. (1991) had earlier estimated the total population of Cape Cormorants to be 1.355 million.

The greater number of cormorants counted in 2017 than by previous surveys at Tigres (Table 1) is likely due to this being a complete census of the island and much of the adjoining mainland coast. However, it is

also possible that the distribution of Cape Cormorants has shifted north in recent years, perhaps as a further continuation of earlier shifts up the Namibian coast reported by Crawford et al. (2007). Kirkmann et al. (2012) describe a similar northward extension of range by Cape Fur Seals, and Cape Cormorants have recently extended their range south-east along the South African coast (Crawford et al. 2016).

We do not know if the groups in Figure 4 are additional to those counted in the aerial survey photographs. However, since the aerial photographs were taken in the first part of the morning on the 1st of March, it is possible that substantial numbers of cormorants could have left the island to feed elsewhere by that time of day. If the cormorants in

Figure 4a and 4b were additional to those counted on the island, it is possible that the Tigres region supports many more Cape Cormorants than the 250,786 birds counted on the aerial census images.

The number of cormorants and seals recorded during this study demonstrates the value of Baía dos Tigres in supporting large numbers of piscivores and the evident wealth of their marine food base. To these can be added substantial numbers of Kelp Gulls; Royal Terns (*Thalasseus maximus*), Greater Crested Terns (*T. bergii*), Caspian Terns (*Hydroprogne caspia*) and Damara Terns (*Sternula balaenarum*); Great White Pelicans, Greater Flamingos (*Phoenicopterus roseus*) and other species reported by Simmons et al. (2006) and Ministério do Ambiente (2017). The area is currently registered as an 'Ecologically or Biologically Significant Area' (EBSA Portal 2018). Efforts now being made by the Angolan government to proclaim Ilha dos Tigres and the surrounding coastal waters as a protected marine area (G Schroth pers. com. 2017) are therefore to be commended and supported.

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