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## AGE AT BREEDING OF CROWNED CORMORANTS *PHALACROCORAX CORONATUS*

R. J. M. CRAWFORD\* and B. M. DYER\*

Between 1991 and 1995, 242 crowned cormorant *Phalacrocorax coronatus* chicks were banded at Malgas Island with metal and colour rings. At least 10 subsequently bred before 4 April 1996. First-year birds had juvenile plumage, but when about one year old they attained the plumage of immature birds and of non-breeding adults. The youngest age at breeding was about one year, but many birds did not breed until aged  $1\frac{1}{2}$ –2 years and some may not have bred before they were three years old.

Crowned cormorants *Phalacrocorax coronatus* are endemic to southern Africa, where they breed between Bird Rock, Walvis Bay, Namibia, and Cape Agulhas, South Africa (Crawford *et al.* 1982, Cooper and Brooke 1986). The species breeds throughout the year (Rand 1960) and the breeding population is about 2 700 pairs (Crawford *et al.* 1982). Age at first breeding is unknown, but when estimating the overall population size from numbers of breeders, it was assumed to be four years, based on information for four extralimital species (Crawford *et al.* 1991).

Age at breeding for crowned cormorants was investigated between 1991 and 1996 by banding chicks at nests on Malgas Island (33°03'S, 17°55'E) off South Africa's Western Cape. The island supports about 80 breeding pairs (Crawford *et al.* 1982). Besides age of first breeding, limited information on dispersal of birds from Malgas Island is also reported.

### METHODS

Crowned cormorant chicks were banded with indi-

vidually numbered 12,5-mm stainless steel rings and with 12,0-mm (internal diameter) coiled, coloured plastic rings of depth 8,5 mm. A total of 242 chicks was banded using nine recognizable colour combinations (Table I). From information on the development of young stages in Williams and Cooper (1983), chicks banded were aged about 10–35 days, from eggs laid some 33–48 days previously.

Subsequent to the first deployment of bands in November 1991, Malgas Island was visited on 56 occasions up to April 1996. During the visits, searches were conducted for live and dead banded birds.

Birds were classified as juveniles or adults, according to plumage characteristics (Crawford *et al.* 1982). A bird was considered to be adult if it was in breeding plumage or the non-breeding adult plumage, which is also the plumage of an immature, as opposed to a juvenile bird (Crawford *et al.* 1982). In non-breeding plumage the abdomen, lower back and rump are black, whereas these body parts are dark brown in juveniles (Crawford *et al.* 1982).

Birds were regarded as breeding if they were occupying active nest sites, i.e. nests with a mate present or that contained eggs or chicks. They were assumed to be non-

Table I: Details of crowned cormorant chicks banded at Malgas Island during the period 1991–1995

Colour combination	Period of banding	Number banded
Yellow and metal, right leg	12 Nov. 1991 – 22 Jan. 1992	33
Metal only, right leg	21 Dec. 1991	1
White and metal, left leg	11 Mar. 1992	20
Black and metal, left leg	11 Mar. 1992	18
Black and metal, right leg	11 Mar. 1992	1
Red and metal, left leg	13 Jan. 1993 – 12 Aug. 1993	51
Green and metal, left leg	15 Feb. 1994 – 14 Dec. 1994	32
Green and metal, right leg	11 Mar. 1994	6
Blue and metal, left leg	23 Jan. 1995 – 29 Oct. 1995	80
Total		242

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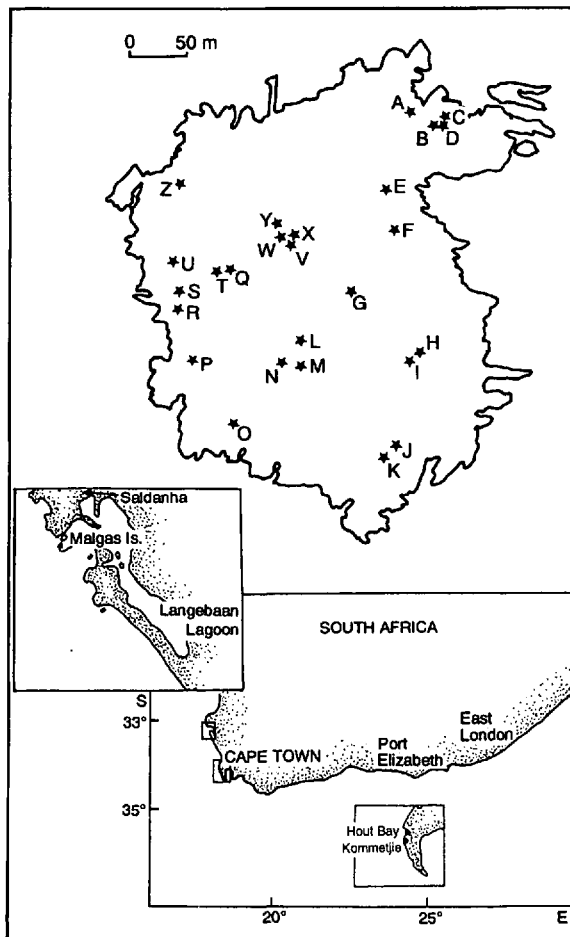


Fig. 1: Map of Malgas Island showing location of sites where crowned cormorants nested during the period 1991–1996

breeders if they were not at an active nest site, even if they were in breeding plumage. The nest sites of breeding birds were recorded between 1991 and 1996 and are shown in Figure 1.

## RESULTS AND DISCUSSION

Two juvenile birds, one observed on 18 May and the other on 29 October 1995 respectively, were banded 207–458 and 252–280 days previously (Table II). The youngest adult bird re-sighted had been banded 85–365 days earlier, and the second youngest 332–583 days

previously (Table II). On this evidence it seems likely that crowned cormorants attain adult plumage when about one year old, at which age there is a complete moult (Crawford *et al.* 1982).

Crowned cormorants with six of the colour combinations were observed breeding at Malgas Island before 4 April 1996 (Table III). Birds with the same colour combination often bred at several discrete sites. For example, birds with red and metal bands on the left leg bred at six sites (Table III). As the species is nomadic between breeding sites (Crawford *et al.* 1994), these do not necessarily represent six individuals. However, when birds with the same colour combination were breeding at different sites (Fig. 1) on the same day, they were assumed to be different individuals. Therefore, a minimum of 10 banded birds bred, consisting of at least three birds with yellow bands, three with red bands, two with blue bands and one each with green and black bands.

The earliest record of breeding by a bird with yellow and metal bands on the right leg (i.e. the oldest birds in the sample) was at about three years of age. A bird with black and metal bands on the left leg was first observed breeding at 3,7 years and one with black and metal on the right leg bred when about 3,8 years. Birds with red and metal and with green and metal on the left legs both bred when  $1\frac{1}{2}$ –2 years old. Birds with blue and metal on the left leg were breeding at ages between 0,4 and 1,2 years (Table III).

The legs of breeding birds are frequently not visible, especially when they are incubating eggs or brooding small chicks. Therefore, observed ages at first breeding may overestimate this parameter. This is especially likely for birds carrying black bands, because the black plastic proved to be considerably less conspicuous than those of other colours.

It is apparent that some crowned cormorants are capable of breeding when about one year old, shortly after their moult to adult plumage. However, many appear not to do so until they are at least  $1\frac{1}{2}$ –2 years old. It is possible that some may defer breeding until aged three years or older.

Information on age at breeding by 10 other cormorants has been collated by Del Hoyo *et al.* (1992) and is summarized in Table IV. In the European shag *P. aristotelis* and the flightless cormorant *P. harrisi*, sexual maturity may be attained in the second year, whereas most great cormorants *P. carbo* breed when 3–5 years old. The other seven species attain sexual maturity when aged between two and four years. The crowned cormorant is one of the smaller cormorants, with an adult mass of 760 g (Crawford *et al.* 1982), and has one of the youngest ages at first breeding. A correlation between age of first breeding and body size is evident in other seabirds (Ricklefs 1972).

Table II: Characteristics and estimated post-banding period of non-breeding crowned cormorants banded as chicks at Malgas Island that were observed in juvenile and adult plumage

Date	Colour combination	Number and maturity state	Time since banding (days)
15 Feb. 1994	Red above metal, left leg	1 juvenile	188 - 399
7 Nov. 1994	Black above metal, left leg	1 adult	972
7 Nov. 1994	Green above metal, left leg	1 juvenile	15 - 266
18 May 1995	Yellow above metal, right leg	1 adult	1 213 - 1 284
18 May 1995	Green above metal, left leg	1 juvenile	207 - 458
18 May 1995	Blue above metal, left leg	3 juveniles	88 - 116
20 Sep. 1995	Yellow above metal, right leg	1 adult	1 337 - 1 408
20 Sep. 1995	Red above metal, left leg	1 adult	770 - 981
20 Sep. 1995	Green above metal, left leg	1 adult	332 - 583
17 Oct. 1995	Yellow below metal, right leg	1 adult	1 364 - 1 435
29 Oct. 1995	Yellow below metal, right leg	1 adult	1 376 - 1 447
29 Oct. 1995	Blue above metal, left leg	1 juvenile	252 - 280
20 Nov. 1995	Blue above metal, left leg	1 juvenile	22 - 302
30 Nov. 1995	Blue above metal, left leg	14 juveniles	32 - 312
22 Jan. 1996	White above metal, left leg	1 adult	1 412
22 Jan. 1996	Red above metal, left leg	1 adult	894 - 1 105
22 Jan. 1996	Blue above metal, left leg	1 adult	85 - 365
15 Feb. 1996	Yellow below metal, right leg	1 adult	1 485 - 1 550
24 Mar. 1996	Green above metal, left leg	2 adults	518 - 769
24 Mar. 1996	Blue above metal, left leg	1 adult	147 - 427
3 Apr. 1996	Blue above metal, left leg	1 adult	157 - 437

Until 4 April 1996 only one dead banded bird was found at Malgas Island. The bird was estimated to have survived about 80 days after it was banded (green and metal rings) on 15 February 1994 (Table I). A member

of the public reported the death of one other bird. It was banded at Malgas Island on 22 January 1992 and recovered at Hout Bay (34°03'S, 18°21'E), 118 km from the island. The cause of death was not known. Juvenile

Table III: Characteristics and estimated post-banding period of banded crowned cormorants breeding at Malgas Island. See Figure 1 for positions of breeding sites

Date	Colour combination	Breeding site	Time since banding (days)
5 Oct. 1994	Yellow above metal, right leg	A	988 - 1 059
24 Oct. 1994	Yellow above metal, right leg	X	1 007 - 1 078
24 Oct. 1994	Yellow above metal, right leg	O	1 007 - 1 078
7 Nov. 1994	Yellow above metal, right leg	J	1 021 - 1 092
14 Dec. 1994	Yellow above metal, right leg	F	1 058 - 1 129
23 Jan. 1995	Red above metal, left leg	E	530 - 741
23 Jan. 1995	Red above metal, left leg	H	530 - 741
20 Feb. 1995	Yellow below metal, right leg	T	1 126 - 1 197
20 Feb. 1995	Red above metal, left leg	T	558 - 769
20 Feb. 1995	Red above metal, left leg	X	558 - 769
14 Mar. 1995	Yellow above metal, right leg	V	1 148 - 1 219
10 Aug. 1995	Red above metal, left leg	H	729 - 940
10 Aug. 1995	Red above metal, left leg	H	729 - 940
10 Aug. 1995	Red above metal, left leg	T	729 - 940
17 Oct. 1995	Black above metal, left leg	H	1 316
29 Oct. 1995	Red above metal, left leg	W	809 - 1 020
20 Nov. 1995	Red above metal, left leg	S	831 - 1 042
20 Nov. 1995	Black above metal, right leg	J	1 350
30 Nov. 1995	Red above metal, left leg	S	841 - 1 052
30 Nov. 1995	Yellow below metal, right leg	O	1 409 - 1 480
30 Nov. 1995	Black above metal, right leg	J	1 360
14 Dec. 1995	Red above metal, left leg	S	855 - 1 066
15 Feb. 1996	Blue above metal, left leg	I	109 - 389
15 Feb. 1996	Green above metal, left leg	J	480 - 731
24 Mar. 1996	Blue above metal, left leg	I	147 - 427
3 Apr. 1996	Blue above metal, left leg	I	157 - 437
3 Apr. 1996	Blue above metal, left leg	J	157 - 437

Table IV: Age at breeding and mass of 10 cormorants *Phalacrocorax* spp., from Del Hoyo *et al.* (1992)

Common name	Species	Age at breeding	Adult mass (g)
Double-crested cormorant	<i>P. auritus</i>	Generally at 3 years	1 670 – 2 100 +
Great cormorant	<i>P. carbo</i>	3–5 years, occasionally 2 years	1 810 – 2 810
Brandt's cormorant	<i>P. penicillatus</i>	Many females and some males breed at 2 years	2 450
European shag	<i>P. aristotelis</i>	Some females breed in second year	2 000
Pied cormorant	<i>P. varius</i>	Sexual maturity at 2 years or more	1 300 – 2 200
Antarctic shag	<i>P. brandsfieldensis</i>	At 4 years, if not before	2 500 – 3 022
South Georgia shag	<i>P. georgianus</i>	At 3 years	2 883
Macquarie shag	<i>P. purpurascens</i>	Sexual maturity generally not until 4 years, but sometimes at 2 years	2 500 – 3 500
Spotted shag	<i>P. punctatus</i>	At 2 years	700 – 1 210
Flightless cormorant	<i>P. harrisi</i>	Sexual maturity can be reached in second year, especially in females	2 500 – 4 000

crowned cormorants have been known to move up to 277 km from nests where they were banded as chicks (Crawford *et al.* 1982).

A crowned cormorant with a red ring on the left leg was seen at Kommetjie (34°08'S, 18°19'E) on 25 February 1996, 128 km from Malgas Island (T. B. Oatley, South African Bird Ringing Unit, pers. comm.). This bird would have been 1½–3 years old, and therefore mature. As birds are nomadic between breeding sites (Crawford *et al.* 1994), it need not necessarily have been breeding at Malgas Island.

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