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COLOUR AND FIRST AGE OF BREEDING IN CATTLE EGRETS AS DETERMINED FROM WING-TAGGED BIRDS

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In a study of marked Cattle Egrets *Ardeola ibis* returning to breeding colonies at the Shortland Wetlands Centre and Seaham Swamp Nature Reserve, New South Wales, first-year birds were classified into four colour categories 'white', 'pale', 'full pale' and 'full coloured', with individuals of each category successfully nesting and raising chicks. Colour did not appear to be a factor affecting capability of breeding as breeding success of these birds was found to be compatible with whole colony results at Shortland and Gatton, Queensland in previous seasons. All second-year birds were found to be full coloured. The majority of returning first-year birds did not nest. Colour and sex appeared to be independent. First-year birds comprised an estimated 13 per cent of birds in the Seaham breeding colony and 57 per cent of foraging flocks in the vicinity of the breeding site.

INTRODUCTION

Although Cattle Egrets *Ardeola ibis* are known to acquire bright orange or buff breeding colours on head, neck, scapular and breast regions during the breeding season, considerable variation in plumage has been noted in breeding colonies for both the African nominate race (*ibis*) and the Asian race (*coromandus*). In the case of the birds of African origin found in South America (*ibis*), Lancaster (1970) reported colours ranging from none (bird is white), through pale salmon, to the typical strong colour for a colony in Columbia, South America, while Woolfenden *et al.* (1976) classified the same race into three plumage classes: White (including birds which often have obscure pale buff patches on forehead and neck), buff

(birds with conspicuous buff patches but lacking plumes) and plumed (typical full colour-plume pattern). They concluded that the colour variation is related to age, but not sex, and that the plumage varies too much to indicate reliably age or breeding condition.

McKilligan (1985) in his three year study at the Gatton breeding colony in Queensland, adopted a two category colour classification for the Asian (*coromandus*) type found in Australia, calling birds which were white or pale coloured 'pale' and all others 'orange'. From observations of marked birds, he determined that all 'pale' birds were first-year, that some first-year birds carried 'orange' colour, and that all older birds were 'orange'.

In 1979, 8.3 per cent of the Gattton colony consisted of pale birds, in 1980, 4.2 per cent, and 1981, 7.9 per cent. McKilligan (1985) calculated that the breeding colony consisted of 9.3-18.4 per cent first-year birds. He also found that first-year birds bred successfully and produced fledglings.

In the seasons 1985-86 and 1986-87, patagial tags were attached to Cattle Egret chicks at the breeding colonies at the Shortland Wetlands Centre, at the edge of Hexham Swamp on the outskirts of Newcastle, and at Seaham Swamp Nature Reserve, on the Williams River, about 32 km north of Shortland. The tagging programme is part of an investigation called Project Egret Watch, of breeding biology, ecology, migration and dispersion patterns of all four species of egret (Great, Intermediate, Little and Cattle) which breed in the Lower Hunter Valley. The tags were colour coded to denote the colony in which the tagging was carried out, and carried numbers identifying the season of tagging and individual birds. This study reports the results of an investigation into colour variation in Cattle Egrets and the age at which they commence breeding. The results complement the findings of McKilligan (1985).

METHODS

Times of observations

During the winter periods between breeding seasons from 1985 to 1987, a weekly watch was maintained using binoculars and telescope on the evening roost at the Newcastle Wetlands Reserve, about half a kilometre south of the site of the Shortland breeding colony. A somewhat less frequent watch was maintained at the Seaham colony roost in the 1986-87 winter.

While the Seaham roost was occupied, in autumn and spring 1987, regular late afternoon evening observations were carried out. Between June 1987 and March 1988 surveys were undertaken once and frequently twice a day of pasture near the roost frequented by Cattle Egrets, between Glenoak and Raymond Terrace, on at least five days per week.

During weekly observation sessions in late September-October 1987, as the pre-season congregations began at Shortland, colleague Greg Baxter kept the birds arriving for pre-roosting gathering in the evening at the Shortland Wetlands Centre breeding site under observation from the Egret Observation Tower, while the author observed the roosting position at the Newcastle Wetlands Reserve.

For the two breeding seasons, the author maintained daily and frequently twice daily watches of up to two hours at the Seaham breeding colony, and at least weekly sessions of 2-3 hours duration at the Shortland colony. Greg Baxter monitored the Shortland colony at least every second day, and frequently daily for periods of up to two hours.

The Seaham observations were made from vantage points, two of which are elevated, on three roads which intersect at the north-western corner of the colony, enabling virtually all nests, except those deep within foliage, to be kept under observation. In 1986-87, there were 370 nests and, in 1987-88, 504 at Seaham.

The Shortland observations were made from a research hide situated in the centre of the colony, from vantage points within the colony reached by wading through the swamp, from the walking track which skirts the eastern and northern boundaries and, in addition during the 1987-88 season, from the egret observation tower on the southern boundary of the colony. During 1986-87, there were over 600 nests of all four species of egrets, and this increased to over 2 000 in 1987-88 with over 1 300 Cattle Egret nests.

Record cards were maintained for each tagged bird sighted, noting location and time of sighting, colour changes in soft parts and plumage, and behaviour, as well as nest contents for nesting birds. The 1987-88 breeding season observations incorporated all events between 23 September, 1987 and 8 March, 1988. This encompassed the period starting from when it was determined that most of those birds observed which had acquired coloured breeding plumage had completed the moult and become coloured, until the vast majority of adults and fledglings had left the breeding site.



Figure 1. 'Full-coloured' Cattle Egret: can be first year bird or older.

Only four tagged birds were located in 1986-87, but 32 were observed in 1987-88. The observations made on these birds are summarized in Tables 1, 2 and 3.

Colour classification

Based on the observations made at Shortland and Seaham, a four category classification of colour was adopted. If signs of pale buff or orange could not be detected through 10×50 binoculars, within the observation range, which varied from a minimum of about 5 m to a maximum of about 100 m, the bird was classified as 'white', carrying no breeding colour or plumes. If wisps or patches of colour could be detected on the neck, back or breast, the bird was classified as 'pale' (See Fig. 1). If the bird was fully coloured on the head, neck, back and breast, typical of strongly coloured birds, but the colour was distinctly pale buff (possibly an equivalent phase to Lancaster's (1970) 'pale salmon' in the nominate race in America), the bird was classified as 'full pale', while birds which are the typical orange were classified as 'full coloured' (see Fig. 2).

All birds, regardless of category, had a small coloured patch on the crown of the head. This develops on nestlings during the latter stages of development before fledging, and can be found on juvenile birds and non-breeding adults, as well as on white first-year birds during the breeding season. This patch did not form part of the classification system.



Figure 2. 'Pale' first year Cattle Egret with young in nest. It has a light touch of buff on head, neck and breast.

RESULTS

Nesting first-year birds in 1986-87

In the 1986-87 breeding season, four tagged birds were located at the breeding colonies. Two Shortland birds (Nos. 1/3/36 and 1/3/38) were sighted at the Shortland colony; the latter was seen on several occasions, but did not nest. Both these birds were classified as 'white'. A third Shortland bird (No. 1/3/33), seen at Seaham at the end of the season, when coloured birds were still in the colony, was also classified as 'white'.

The fourth (No. 9/5/29) was a Seaham bird, carrying full, rich orange breeding colour and plumes, and it was observed displaying in full courting flush. When Cattle Egrets are courting, the eyes, soft facial parts, beaks and legs adopt a magenta red colour. This bird was associated with a 'full-pale', and was carrying out the typical heron-type courting behaviours of 'twig-shake' and 'back biting' as described by Blaker (1969) for the African race. By 17 November, this bird had lost the flush of courting magenta and was established at a nest, where it and its mate were engaged in nest building behaviour. On 18 November, it was observed sitting on the nest without the mate. At 0745 Summer Time on 19 November, both birds were again on the nest, but at 1650 hours both were missing, and were not seen again on the site, nesting having apparently been abandoned.

On 13 December, No. 29 was again located sitting on a nest, this time at a different but nearby site. It had mated with a white bird, with a clearly defined buff cap on the head crown. The birds shared brooding responsibility until 4 January (22 days). On 5 January, the nest was empty and not occupied thereafter, any eggs present apparently having failed to hatch.

It is certain that the two birds at Shortland did not nest, and highly unlikely that the Shortland bird (1/3/33) seen at Seaham had nested. Thus at least one of the four returned first-year birds nested.

Nesting of first-year birds in 1987-88

In 1987-88, 26 first-year birds (13 from each colony) were identified at the breeding colonies or in the nearby feeding ranges during the breeding season. Two Shortland birds, one of which (No. 1/3/36) had been observed as a 'white' first-year bird in 1986-87, had remained in the district throughout the winter using the evening roost at Newcastle Wetland Reserve, but the remainder of the Shortland birds and all the Seaham birds were not sighted anywhere during the winter. Sightings of the returning birds began to be made from early August onwards.

Nine were classified as 'white' (35%), eight as 'pale' (31%), three as 'full pale' (12%) and six as 'full coloured' (23%). Using McKilligan's (1985) system of pale and orange, 77 per cent would be classified as pale and 23 per cent orange. These results are summarized in Table 1. Nests of six of these birds were located, and Table 2 summarizes the plumage states of the tagged birds, their mates and nesting successes.

Two 'white' birds, two 'pale', one 'full pale' and one 'full coloured' established nests. A 'white' bird (9/4/64) returned to Seaham, where it mated with a 'full coloured', established a nest, sat for eight days and then abandoned the nest. It was observed on four occasions between the date of abandonment (8 December) and 4 January but there was no evidence of re-nesting. The other 'white' bird (1/4/114), with a 'full pale' mate, nested successfully at Shortland, and raised three chicks.

Of the 'pales', 1/4/63 at Shortland mated with a 'full coloured' and successfully raised three chicks, and 9/4/97 at Seaham mated with a 'pale' (even paler than itself) and successfully fledged two chicks.

The 'full pale' Seaham bird (9/4/49) mated with another 'full pale', and the 'full coloured' Seaham bird (9/4/77) mated with another 'full coloured' bird, both pairs successfully raising two chicks.

TABLE 1

Colour classification of nestling of Cattle Egrets tagged as chicks in Project Egret Watch 1986-87, 1987-88.

		White	Pale	Full pale	Full coloured	Total	Nested or fledged chicks
First-year birds 1986-87	n	3	0	0	1	4	1
First-year birds 1987-88	n	9	8	3	6	26	6
Second-year birds	n	0	0	0	6	6	3
Using McKilligan (1985) Classification.							
	Pale	Orange					
n	20	6					

TABLE 2

Nesting status of marked Cattle Egrets 1986-87, 1987-88.

Bird No.	Tagging location	Date tagged	Age	Season	Nested	Plumage	Plumage mate	Nest status	Chicks
9/3/29	Seaham	08.02.86	1	1986-87	Yes	FC	FP	F	0
				1987-88	Yes	FC	FC	F	0
1/3/20	Shortland	29.01.86	2	1987-88	Yes	FC	U	U	U
1/3/38	Shortland	22.02.86	1	1986-87	No	W	—	—	—
			2	1987-88	Yes	FC	W	S	1
9/4/64	Seaham	27.12.86	1	1987-88	Yes	W	FC	F	0
1/4/114	Shortland	12.02.87	1	1987-88	Yes	W	FP	S	3
1/4/63	Shortland	10.01.87	1	1987-88	Yes	P	FC	S	3
9/4/97	Seaham	19.01.87	1	1987-88	Yes	P	P	S	2
9/4/49	Seaham	27.12.86	1	1987-88	Yes	FP	FP	S	2
9/4/77	Seaham	27.12.86	1	1987-88	Yes	FC	FC	S	2

W=White; P=Pale; FP=Full Pale; FC=Full Coloured; F=Failed Nest; S=Successful Nest; U=Unknown Outcome.

Nesting of second-year birds 1987-88

Six second-year birds returned, including 1/3/36, 1/3/33, 1/3/38 seen as non-nesting 'whites' in 1986-87 and 9/3/29, the full-coloured bird which failed to hatch chicks at Seaham in the previous season. Nests of three were found.

No. 9/3/29 at Seaham mated with a 'full coloured' bird and nested at the opposite end of the colony from where it had made its two attempts the previous season, and breeding again failed, after sitting for 25 days. On the fifth and sixth day after the nest was abandoned, this bird was seen near the site, having regained full courting magenta, displaying with 'snap' and 'twig shake' behaviours (Blaker 1969), but then disappeared.

Shortlands 1/3/38, a 'white' of the previous season, was in 'full colour', and mated with a 'white' (first-year) bird to fledge one chick. Shortland's 1/3/20 was also a 'full-coloured bird'. However, its nest position was difficult to observe and no observations of its mate or the outcome of the nest were obtained.

Returns for which nests were not located

Results of observations of marked birds for which no nests were located are summarized in Table 3. Of first-year birds, no nests were located

for three out of four in 1986-87, and for 20 out of 26 (77%) in 1987-88. Of the 1987-88 season second-year birds, nests were found for only three of the six.

Seven out of nine birds classified as 'white' were known to have failed to nest or to have been unlikely to have nested. For the 'pale' birds, 75 per cent were classified as non- or unlikely nesters, and for the 'full coloured', 83 per cent. In the case of the 'full pales', behaviour and plumage colour for 9/5/66 over 11 observations suggested that it may have nested, in which case no bird in this category could be definitely classified as a non-nester.

Of the birds for which no nests were found, magenta courting colours were observed on six of the first-year birds and on two of the second-year birds. One first-year bird was observed occupying a nest site over four days, but no magenta, no display and no mate were observed, and no building was undertaken. Another first-year 'pale' was observed in magenta over a three-day period in early December, later displaying with 'twig shake' (Blaker 1969), without the magenta flush, in late December and early January. It still carried the pale feather colours on 22 January, but had lost all plumage colour by 14 March.

Of the second-year birds, one appeared at the Seaham colony in magenta colours only once (2

November), when only a few nests were established, and was not seen again. Shortland bird 1/3/33, which had been seen at Seaham as a 'white' bird at the end of the previous season, was observed in 'full colour' at Shortland on 13 November, and then at Seaham on 28 December, displaying in magenta courting colours.

Because of the ease and intensity of observation at Seaham, it is unlikely that a nesting tagged bird could have been missed completely. The likelihood was higher at Shortland because of the

extent and density of the colony, but with two observers covering parts of the colony intensely and the rest at regular intervals, it is still unlikely. Sightings of tagged birds not known to have nested ranged from single sightings through to 11, 15 and 19 observations. Based on the number of sightings, behaviour, the state of plumage and colours when sighted, and the location of the sighting, ten cases were classified as definite non-nesters, ten others as unlikely to have nested, and one as possibly having nested without the nest being found (see Table 3).

TABLE 3

Colour variations of marked Cattle Egrets sighted breeding seasons 1986-87, 1987-88. No nest located.

Bird No.	Tagging location	Date tagged	Age	No. of sightings	Season	Plumage	Seen magenta	Seen display	Nest
1/3/33	Shortland	22.02.86	1	2	1986-87	W	—	—	—
			2	2	1987-88	FC	Yes	Yes	U
1/3/36	Shortland	22.02.86	1	3	1986-87	W	No	No	No
			2	3	1987-88	FC	No	No	U
9/3/04	Seaham	11.01.86	2	1	1987-88	FC	Yes	No	No
1/4/57	Shortland	10.01.87	1	2	1987-88	W	No	No	No
1/4/64	Shortland	10.01.87	1	1	1987-88	W	No	No	U
1/4/72	Shortland	22.01.87	1	5	1987-88	W	No	No	No
1/4/84	Shortland	22.01.87	1	1	1987-88	W	No	No	U
1/4/99	Shortland	12.02.87	1	8	1987-88	W	Yes	No	U
9/4/47	Seaham	27.12.86	1	3	1987-88	W	Yes	No	No
9/4/104	Seaham	03.02.87	1	19	1987-88	W	No	No	No
1/4/67	Shortland	10.01.87	1	3	1987-88	P	No	No	U
1/4/75	Shortland	22.01.87	1	1	1987-88	P	No	No	U
1/4/98	Shortland	12.02.87	1	1	1987-88	P	No	No	U
9/4/74	Seaham	27.12.86	1	15	1987-88	P	Yes	Yes	U
9/4/86	Seaham	19.01.87	1	7	1987-88	P	No	Yes	U
9/4/106 (female)	Seaham	08.02.87	1	4	1987-88	P	Yes	Yes	U
1/4/83	Shortland	22.01.87	1	2	1987-88	FP	No	No	No
9/4/66	Seaham	27.12.86	1	11	1987-88	FP	Yes	Yes	P
1/4/89	Shortland	06.02.87	1	1	1987-88	FC	No	No	No
1/4/102	Shortland	12.02.87	1	2	1987-88	FC	No	No	No
1/4/107	Shortland	12.02.87	1	1	1987-88	FC	No	No	U
9/4/44	Seaham	27.12.86	1	2	1987-88	FC	No	No	No
9/4/76	Seaham	27.12.86	1	1	1987-88	FC	Yes	No	U

W=White; P=Pale; FP=Full Pale; FC=Full-Coloured; U=Unlikely to have nested; P=Possibility of having nested.

For the 1987-88 season, where numbers are high enough for some conclusions to be drawn, it would seem that as high as 77 per cent of first-year birds, and possibly 50 per cent of second-year birds did not nest, even though they returned to the colony area for the breeding season.

Breeding success of first-year birds

From seven nests of first-year birds over the two seasons, young were fledged in five (71%). Two raised three chicks and three raised two (mean 2.4). The mean was 1.7 if the two failures are included.

Plumage, age and nesting

The results suggest that plumage and age may not be major factors related to nesting capability. Apart from the colour combinations noted for marked birds which successfully raised chicks (see Table 2), all possible colour combinations have been observed in unmarked birds to successfully establish nests and fledge young. McKilligan (1985) reported similar variation.

Three of the six marked first-year birds in 1987-88 are known, by colour of mate, to have paired with a first-year bird, and all of these fledged chicks (3, 2, 2). White \times White pairing is not uncommon at either colony, and one pair at Seaham, kept under observation for the duration of nesting in 1987-88, successfully fledged young. Numerous unmarked all-white birds were observed in both colonies early in the nest establishment phase of the colony with typical magenta courting colour on face and beak and a crown cap more orange than normal.

Some of the full-coloured birds observed to have mated with the pale coloured and white birds must be second-year or older birds. No. 1/3/38, which had been observed as a 'white' without breeding at Shortland in 1986-87, returned as a second-year bird in full colour and mated with a 'white' bird at Shortland in 1987-88. This pair successfully fledged one chick.

Proportion of first-year birds

No count of first-year birds in the colony equivalent to McKilligan's (1985) has been carried out at the Hunter Valley colonies, but,

in the 1987-88 season, the proportion of 'white' birds in total flock numbers were determined from counts in flocks using pastures near the Seaham colony. The counts were made between 23 September, when it was determined that acquisition of breeding colour was well advanced, and 25 November, when the first chicks were noted at Seaham. From 149 counts, 1 833 birds were counted, of which 363 (19.8%) were classified as 'white'.

Using the percentage of white birds in the 26 known first-year tagged birds (35%) as a basis, it was estimated that 57 per cent of the total birds observed were first-year of all colour categories. This figure would be significantly higher than the number of first-year birds likely to be observed within the colony at other than evening roost time, and cannot be used as a direct comparison with McKilligan's (1985) results.

However, if the 77 per cent figure for marked first-year birds for which no nests were found is used, this leaves 23 per cent of the 57 per cent of first-year birds in the pasture flocks that could be classified as potential nesters at the colony. This gives an estimate of 13 per cent as the likely proportion of first-year birds in the colony proper, which falls within McKilligan's estimated proportion of first-year birds at Gatton of 9.3-18.4 per cent.

Colour and sex

Some evidence has been accumulated that suggests the distribution of the four colour stages in first-year birds is probably independent of sex. One rehabilitated bird, fostered and released in 1986-87, was sexed using laparoscopy as female by the Shortland Wetlands Centre's honorary veterinarian, Graeme Brown. It returned as a 'pale' in 1987-88. Two chicks maintained in captivity over the winter as part of Greg Baxter's study on diet of Cattle Egrets were also sexed by the veterinarian, one as a male, one as a female. Both gained breeding plumage to 'pale' status as first-year birds.

One 'full pale' bird was observed in detail from first display right through its breeding cycle. It carried out all the behaviours described in the literature on African race birds (e.g. Blaker 1969) as typical of a male, particularly the

intensity of stick gathering. A number of pairs of 'white' birds have been observed nesting successfully.

DISCUSSION

The results obtained in this study confirm McKilligan's (1985) conclusions that Cattle Egrets are capable of breeding successfully in their first-year, that birds coloured from white through to a full coverage of pale buff colour are first-year birds, that some first-year birds carry a full cover of typical orange plumage, and that second-year or older birds carry full orange colour. A four category ('white', 'pale', 'full pale', 'full coloured') system was adopted to provide a more definitive description of the feather colour variations which exist when birds are in breeding plumage. All birds carrying the first three categories can be defined as birds in their first year, but the 'full coloured' first-year birds are indistinguishable from older birds.

The term 'first-year' has been adopted, rather than 'one year old' because some may be as young as eight months when colour acquisition commences, and as young as ten months when nesting begins.

Breeding success of the first-year birds found nesting is similar to the overall success found for the Shortland colony in 1981-83 (Maddock 1986) and at Gatton 1979-82 (McKilligan 1985). Although the sample is small, the results are suggestive that neither colour nor age are major factors in determining breeding capability.

The value of 2.4 young per nesting pair obtained for fledging success of the marked birds is lower than the colony figure of 2.6 obtained from the 1982-83 and 1983-84 seasons at Shortland (Maddock 1986), but higher than McKilligan's (1985) three season value of 2.1 for the Gatton colony over the period 1979-82. The value for all nesting attempts (1.7), however, falls within McKilligan's range of 1.5-1.8 young per nesting pair.

Only 23 per cent of the observed first-year marked birds were found actually nesting. Some were never observed carrying courting magenta of face, eyes and legs or displaying, others were. Although it is not certain that all nests of the marked birds were found, it is unlikely that any discrepancy is large, and hence it can be conjectured that the majority of first-year birds returning to a colony in the breeding season do not nest. The estimated 13 per cent of first-year birds in the breeding colony is within the range estimated for McKilligan's (1985) Gatton, Queensland colony.

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