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EFFECT OF PATAGIAL TAGS ON CATTLE EGRETS

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The effect of patagial tags is evaluated for 3 265 Cattle Egrets banded and tagged as nestlings over seven seasons.

Tagging did not affect fledging ability of nestlings, nor did tagging operations increase nestling mortality in the colony. Mortality of first year birds was comparable to that recorded in other studies, but adult mortality appeared to be greater. The presence of patagial tags on at least one member of a pair did not affect the mean number of young fledged.

There was no difference in the mean number of young fledged from nests containing tagged chicks and those with no tagged chicks. Tag loss was recorded in only a few nestlings and for 21 per cent of returning first year birds. The loss of a tag did not affect the behaviour of the bird but did reduce the efficiency of field observations. However, tag loss was not considered to be a major reason for declines in the number of observations where observer effort was high.

Patagial tagged egrets had the capacity to carry tags repeatedly on long distance migrations similar to that of untagged birds.

By attaching patagial tags to nestlings, far more data on the biology, ecology and migration of Cattle Egrets has been obtained than would have been possible with unmarked, metal banded or colour banded birds. Such data could be of reduced value if the tags materially affect the behaviour of the individual or population. By examining both tagged and untagged portions of populations wherever possible we have demonstrated that patagial tags are an invaluable tool for research on egrets.

INTRODUCTION

The need in many studies to identify individuals has led to the development of a number of marking techniques. Patagial tagging is a relatively recent development and has proven to be an effective method of marking individual birds. This is particularly so for those species that are difficult to recapture or do not lend themselves to other forms of colour marking, for example those that have short tarsi or spend much of their time with legs obscured.

Materials used for patagial tags include various plastics (Anderson 1963; Hester 1963; Hewitt and Austin-Smith 1966; Parry 1967; Brereton and Pidgeon 1968; Southern 1971; Maddock 1989), and stainless steel and anodised aluminium (Rowley and Saunders 1980).

Patagial tags can be of great benefit to the researcher by facilitating repeated sightings of individually marked birds and have been used on a range of birds including waterfowl, parrots, cockatoos, waders, raptors, ravens and other passerines. There is, however, some literature indicating adverse effects of tags on birds. Reported drawbacks of the use of patagial tags include a higher rate of nest desertion and negative behavioural responses for eiders *Somateria mollissima* (Anderson 1963), increased predation of cockatoos (Rowley and Saunders 1980; Saunders 1988) and a decline in the migratory return of Willetts *Caloptrophorus semipalmatus* (Howe 1980) and Red-billed Gulls *Larus delawarensis* (Southern and Southern 1985).

In this paper we evaluate the effect patagial tags have on Cattle Egrets *Ardeola ibis*.

METHODS

Between 1985 and 1992, 3 265 nestling Cattle egrets have been marked with patagial tags at seven colonies in northern New South Wales and at one colony in southern Queensland. Tags are made of Pennant Flag Cloth and fitted on both wings using the method described by Maddock (1989) except during 1990–91 when 100 nestlings had the tags fitted with the use of monel metal poultry wing bands. A further 433 Cattle Egrets were tagged in this manner during 1991–92. The poultry wing bands are V-shaped clips with a spike on the end of one arm of the V which fits into a hole on the end of the other arm after passing through the tag and the patagium.

Intensive observations of both tagged and untagged Cattle Egrets have been carried out in the breeding colonies, feeding grounds around the colonies and at wintering sites by volunteer observers throughout eastern Australia and New Zealand. Observation effort was highest at the Seaham colony near Raymond Terrace, New South Wales at which, due to its small size, virtually all nests are able to be observed. As a result most quantitative results presented here were obtained at this colony. Observer effort was also high at the Shortland colony some 30 km south of Seaham as well as the Junction Hill and Lawrence colonies near Grafton, New South Wales. Because of the size of the colony and/or its topography, observation of all nests was not possible at these colonies. The location and a description of the colonies has been provided in Geering (1993).

Such intensive observations have enabled good estimates to be obtained of survival rates of wing tagged nestlings, survival of first year and adult birds, return of tagged birds to the natal and other colonies and breeding success of tagged birds. The use of volunteer observers has provided the basis for the formulation of an excellent picture of Cattle Egret migration resulting from the sighting of patagial tagged birds (Maddock 1990; Maddock and Geering, in press).

RESULTS

Survival of first year birds and adults

Survival of first year Cattle Egrets was calculated from sightings of tagged birds from four breeding seasons, 1986–87 to 1989–90 for the Seaham and Shortland colonies, the 1988–89 and 1989–90 seasons for Lawrence and the 1989–90 breeding season for Junction Hill.

Survival of these cohorts ranged from 14.4 to 40.7 per cent with significant differences occurring between years and at times between colonies within a given year. Pooled data for birds produced in these four breeding seasons provides survival rates from 18.6 to 37.1 per cent (Table 1). Survival rate for all first year Cattle Egrets tagged 1986–87 to 1989–90 was 26.4 per cent, a mortality rate of 73.6 per cent.

Using the number of birds known to be alive at the end of the previous year, based on field sightings, a crude measure of survival of adult birds was calculated (Table 1). Survival of second year birds from specific colony/year cohorts ranged from 27.3 to 93.3 per cent, third year birds 33.3 to 70.9 per cent, fourth year birds 0 to 66.7 per cent and fifth year birds 0 to 100 per cent. The sample size of the older cohorts was small and did not provide a reasonable estimate. The data suggested that survival between years can differ substantially. The overall survival rate of adult birds was about 50 per cent (Fig. 1).

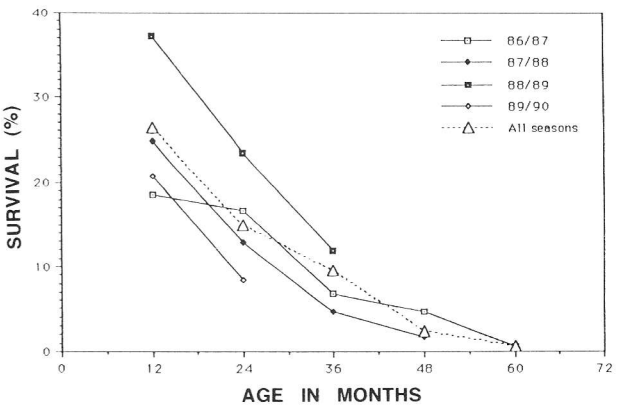

Figure 1. *Survival of patagial tagged Cattle Egrets.*

TABLE 1

Age-specific survival of Cattle Egrets tagged as nestlings.

Breeding season	Age in months	Shortland No. Alive	Shortland % Surv.	Seaham No. Alive	Seaham % Surv.	Lawrence No. Alive	Lawrence % Surv.	Junction Hill No. Alive	Junction Hill % Surv.	Pooled No. Alive	Pooled % Surv.
1986–87	12	15	21.4	12	16.0	—	—	—	—	27	18.6
	24	14	93.3	10	83.3	—	—	—	—	24	88.9
	36	5	35.7	5	50.0	—	—	—	—	10	41.7
	48	1	20.0	3	60.0	—	—	—	—	4	40.0
	60	1	100.0	0	0.0	—	—	—	—	1	25.0
1987–88	12	15	23.5	15	25.9	—	—	—	—	30	27.5
	24	8	53.3	6	40.0	—	—	—	—	14	46.7
	36	3	37.5	2	33.3	—	—	—	—	5	35.7
	48	2	66.7	0	0.0	—	—	—	—	2	40.0
1988–89	12	16	24.6	28	40.0	106	37.6	—	—	150	37.1
	24	12	75.0	22	78.6	61	57.5	—	—	95	63.3
	36	8	66.7	8	36.4	32	52.5	—	—	48	50.5
1989–90	12	11	40.7	33	32.7	41	18.8	29	14.4	114	20.8
	24	3	27.3	19	57.6	15	36.6	9	31.0	46	40.4

Breeding success

There was no significant difference between the mean number of nestlings fledged by 556 successful Cattle Egret nest pairs which had neither parent tagged (2.24) and 66 successful nests where at least one parent was tagged (2.11) (Table 2).

The impact of the wearing of patagial tags by adults on nest failure was not determined because it was not possible to obtain comparative data from non-tagged birds. The nests included in the non-tagged sample were identified only after stable incubation had commenced. It was therefore impossible to identify all early failures of unmarked birds because individuals could not be identified and abandoned nests are quickly re-occupied by other birds.

TABLE 2

Nesting success: Tagged parent Cattle Egrets compared with untagged 1987–88 to 1991–92.

	No. nests	Young Fledged 1	2	3	4	5	Mean	SD
Tagged parent	66	12	36	17	1	0	2.11	0.70
Untagged parents	565	83	287	157	28	1	2.24	0.77

Difference in Means 0.13, t = 1.14, df = 619, $p > 0.05$.

Survival of wing tagged nestlings

Nestlings given patagial tags at the Shortland colony did not have a mortality rate higher than untagged young nor did the activities associated with tagging increase mortality of nestlings (Baxter 1992).

The percentage of tagged nestlings at Seaham that subsequently fledged was 89.5 per cent and 74.25 per cent for the 1988–89 and 1989–90 breeding seasons respectively. The fate of a number of birds is unknown but taking into account the elapsed time between tagging, the last sighting and the age of the bird when tagged, fledging success can be estimated at around 86 per cent, ranging from 83.2 per cent (adjusted) to 89.5 per cent (adjusted) over the two breeding seasons (Table 3).

TABLE 3

Survival of patagial tagged nestling Cattle Egrets at Seaham.

Season	Fledged	Fostered	Dead	Unknown
1988–89				
No. birds	51	0	2	4
%	89.5	0	3.5	7.0
Adjusted %	89.5	0	10.5	0
1989–90				
No. birds	75	1	10	15
%	74.25	1	9.9	14.85
Adjusted %	83.2	1.0	14.9	1.0

TABLE 4

Success of Cattle Egret nests with tagged nestlings compared with nests with no tagged nestlings 1988–89 and 1989–90.

	No. nests	No. Fledged 0	1	2	3	4	Mean	SD
With tagged nestlings	73	1	6	33	30	3	2.38	0.72
With no tagged nestlings	179	10	16	76	66	11	2.30	0.84

t test for samples of different variance: difference in means 0.08, t = 0.73, df = 197, $p > 0.05$.

There was no significant difference between the mean number fledged from 73 nests containing tagged Cattle Egret chicks (2.38) and 179 nests containing no tagged nestlings (2.30) over the 1988–89 and 1989–90 breeding seasons at Seaham (Table 4).

Tag loss

Some tag loss from chicks between tagging and fledging has been noted, as well as tag loss during the life of adults. Records from the Seaham colony, where observation has been consistent over several years, give some indication of the extent of this loss for nestlings.

In the 1989–90 breeding season, seven of 100 nestlings tagged at Seaham lost one tag before fledging but in 1990–91 only one of 130 lost a tag, representing an overall loss of 3 per cent. In 1988–89, the middle sibling out of a nest of three tagged nestlings lost both tags before fledging, the only instance of double tag loss from a nestling recorded.

Tag loss at Seaham was assessed for birds from nests in *Melaleuca quinquenervia* . At Junction Hill many birds also nest in *Acacia melanoxylon* and during 1990–91 a small number of nestlings from these trees was tagged. Although quantitative data is not available, tag loss in these trees appeared to be greater than for tagged nestlings in *M. quinquenervia*. It is the opinion of one of the authors (DJG) that nestlings in this tree type are more prone to catching tags on fine twigs resulting in the tag tearing through the patagium.

Over four years (1986–87 through 1989–90) 34 first year birds returned to the Seaham colony with one tag missing. This represented 21 per cent of first-year birds (n = 161) that returned. One of 54 birds observed in their second year and two out of 10 observed in their fourth year had also lost one tag.

A tagged nestling that was successfully fostered in captivity after being rescued from drowning lost a tag shortly before its release. The tag was found to have torn through the patagium but this did not affect the bird's capacity to fly in any way.

Migration

Large numbers of Cattle Egrets have been banded with Australian Bird Banding Scheme metal leg bands at 14 breeding colonies in coastal southern Queensland and northern New South Wales since the late 1970's. Colour banding or patagial tagging at nine of these colonies was used primarily in the early 1980's. Recoveries of non-patagial tagged birds have been made throughout south-eastern Australia and New Zealand (Maddock 1990; ABBBS, pers. comm.).

In this study patagial tagging of Cattle Egrets commenced in 1985. Over 12 500 recoveries or sightings of patagial tagged Cattle Egrets have been made by members of the public throughout southeastern Australia from Bundaberg (Queensland) in the north to Tasmania, Victoria, South Australia and both islands of New Zealand (Maddock 1990; Maddock and Geering 1993). Although the great majority of these sightings were within or near breeding colonies, many sightings were reported from almost the entire wintering range of the species in southeastern Australia and New Zealand.

A comparison of the recoveries of 2 154 metal banded, 178 colour banded and 1 200 patagial tagged birds for Cattle Egrets banded at the Lawrence and Junction Hill colonies (Table 5) indicate that tagged birds have migrated similar distances to similar locations as metal and colour banded birds. With the exception of New Zealand, wing tagged birds from these two colonies have been reported throughout the area represented by recoveries of metal banded and colour banded

TABLE 5

Number of recoveries of metal banded, colour banded and patagial tagged Cattle Egrets banded as nestlings at the Lawrence and Junction Hill breeding colonies.

	Metal banded	Colour banded	Patagial tagged
No. marked	2 154	178	1 200
Distance from colony (km)	No. Recoveries		
0–100			12
101–200			29
201–300	1		11
301–400	1	2	63
401–500			7
501–600			1
601–700	1		20
701–800			
801–900			1
901–1 000			1
1 001–1 100			4
1 101–1 200			1
1 201–1 300	1		7
1 301–1 400			
1 401–1 500			2
1 501–1 600		1	2
1 601–1 700	2		1
1 701–1 800			1
2 201–2 300	1		
2 301–2 400		1	

birds. There have been, however, four patagial tagged Cattle Egrets from other colonies reported in New Zealand.

Sightings of patagial tagged birds have provided many examples of birds returning from distant wintering sites to natal and, occasionally, other breeding colonies. Fifty-three departure and return movements have been recorded for the Lawrence, Junction Hill, Seaham and Shortland colonies and a number of these birds returned to the same wintering location, in several cases for four successive winters. These latter movements range from 30 kilometres to over 1 000 kilometres (Maddock and Geering 1993). Although a Shortland tagged bird has been seen in New Zealand in two successive winters, return movements from New Zealand have yet to be reported. The absence of any sightings of this bird in New Zealand during the summer suggest it may have returned.

DISCUSSION

Survival of tagged birds

The survival of patagial tagged nestlings is comparable to non-tagged nestlings. Baxter (1992) used three methods of determining the mortality rate of nestlings during the breeding seasons 1987–88 to 1989–90 and found no significant difference in fledging of tagged and non-tagged Cattle Egrets at Shortland. Between 1.6 and 2.0 young fledged per nest, a figure within the higher portion of ranges reported by other authors (Baxter 1992).

It is difficult to draw direct comparisons between these data and that of other authors because of differences in the methods used. Siegfried (1972) reported a mortality rate in Cattle Egrets of only 3 per cent after three weeks of age with 0.86 young fledging per nesting pair from a mean clutch size of three. This fledging rate is significantly lower than that reported in Australia (McKilligan 1985; Maddock 1986; Maddock and Baxter 1991; Baxter 1992) and may stem from a high mortality of small nestlings reducing pressure on survivors. Fledging success in the Cattle Egret may reflect the stage of development of a colony with fledging rates declining as breeding pressure increases (Maddock, unpublished data).

Once a nestling has reached a size where the wing has developed sufficiently to accommodate the tag, generally greater than three to four weeks of age, its chances of survival are relatively good.

Mortality of first year Cattle Egrets (73.6%), based on tag sightings, is comparable to Kahl's (1963) 76 per cent for Common Egrets *Casmerodius albus* and an average of 70 per cent for four other heron species based on band recoveries in the USA (Kahl 1963). It is, however, significantly greater than Siegfried's calculated mortality of 37 per cent of first year Cattle Egrets in South Africa. Such a difference is difficult to explain.

Survival, as judged by field sightings, of second year and older birds is not as clearly defined as first year birds. The crude overall mortality rates presented here, based on birds known to be alive

at the end of the previous year, is about 50 per cent. This differs considerably from Kahl's (1963) 26 per cent mortality for adult Common Egrets and an average adult mortality rate of 29 per cent for six populations of four heron species (Kahl 1963) and Siegfried's (1970) 25 per cent mortality of adult Cattle Egrets in South Africa.

Tag loss has been demonstrated but it is uncertain to what degree the loss of both tags contributes to the loss of the bird from the record. There was only one known case where tag loss sometime after the second year was confirmed by reading of the metal band. Although the sighting of tagged birds can be used as a crude measure of survival, caution should be exercised until more data is available.

The possibility that the difference in adult survivorship presented here and by other authors may in part be due to the presence of tags on the birds making them a more visible target for predators cannot be discounted but no strong supporting evidence for this hypothesis has been obtained to date. The causes of death known for a number of tagged egrets include collisions with power lines (n = 1), collisions with motor vehicles (n = 2), collision with a train (n = 1), drowned at sea (n = 1), killed by mammals (n = 3) and birds of prey (n = 3), and one bird that was shot. Two birds were reported as found sick or injured while seven birds were reported as cause of death unknown.

With the possible exception of the bird known to have been shot, the presence of the tags almost certainly had no bearing on the death of these birds. Three reports of the recovery of tags, where birds were preyed on by White-bellied Sea-eagles *Haliaeetus leucogaster* and a fox *Vulpes vulpes*, indicated that a number of other carcasses were also present. This suggests that the tagged bird was not preferentially selected by the predator. Cattle Egrets are known to have a number of natural predators including eagles (Baxter 1988), kites (Geering 1993), falcons (Morrison 1987; Baxter 1988; Reside 1992) and mammals such as foxes.

Saunders (1988) suggested that the glinting of the stainless steel patagial tags used on Carnaby's Cockatoo *Calyptorhynchus funereus latirostris* in Western Australia resulted in these birds being preyed on the Wedge-tailed Eagles *Aquila audax* at a higher than normal rate. Given the conspicuous white plumage of egrets the presence of a wing tag is unlikely to make the bird more obvious although the oddity factor mentioned by Saunders (1988) may allow individual birds to be singled out. This was possibly the case for the bird that was shot.

The relatively high return rate of patagial tags from dead birds, in relation to metal leg bands, is unlikely to be the result of a higher mortality rate but rather a product of the tags making the body more obvious. This is supported by the number of tags returned without the metal band, which were often not seen on the carcass.

Breeding success

Based on a study over two breeding seasons, the presence of a tag on one member of a mating pair, or the presence of tagged chicks in a nest do not seem to affect fledging success. In both situations there was no significant difference between the number of chicks fledged.

It was not always possible to tag all chicks in a nest, due to scrambling behaviour of older members of the brood, but the tag did not seem to be a disturbing factor to the other chicks. Chicks are tagged at about three weeks of age or older, by which time the brood number is usually stabilized.

Migration

The number and pattern of sightings of tagged egrets throughout south-eastern Australia and in New Zealand as presented in Table 5, as well as in Maddock (1990) and Maddock and Geering (1993), indicate that the migration pattern of patagial tagged Cattle Egrets is similar to that for metal banded or colour banded birds. This also reflects the migration of unbanded birds. The number of migrating birds returning and departing indicates that patagial tags were not influencing migration. The lack of a confirmed return of a tagged bird from New Zealand is probably due to the small number of tagged birds that have been seen there to date.

Tag loss and observation

About 20 per cent of first-year birds returning to the breeding colony have only one tag, with some loss being incurred after fledging. This reduces the efficiency of field observations at foraging grounds and in the nesting colony as foraging birds or birds on the nest may face one direction for a long period of time, and the presence of a tagged bird may be missed if the tag is on the opposite wing. However, over prolonged and repeated observations, the chances of seeing both sides are high, and the authors consider that the loss of one tag has not been a major factor reducing the number of observations of a bird.

Loss of both tags is difficult to detect and to date, after two years, only one complete loss has been confirmed by the reading of the metal band in the field. Further data on tag loss is required. Based on probability, a continued 20 per cent loss of tags would result in a rate of double tag loss of 4 per cent a year. However, such factors as the tagging technique of individual banders, a weakness in materials used to attach the tag and even the tree type in which the nestling is situated may play a part in tag loss. It is therefore likely that tag loss is greatest in first year birds.

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