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FLEDGING SUCCESS OF EGRETS IN DRY AND WET SEASONS

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Fledging success for Great, Little and Intermediate Egrets at a breeding colony at Shortland (Newcastle, N.S.W.) was found to increase significantly between the wet 1982-1983 and the dry 1983-1984 breeding seasons, whereas for Cattle Egrets there was no significant difference. Evidence of diet changes obtained during the 1984-1985 drought season, coupled with observations of behaviour in the colony during breeding seasons, suggest the hypothesis that the relationship between seasonal food availability and lethal aggression between siblings is the critical factor at work in determining breeding success.

Since the 1981-1982 breeding season, a breeding colony of all four species of egrets found in Australia (Great: *Egretta alba*, Little: *E. garzetta*, Intermediate: *E. intermedia*, Cattle: *Ardeola ibis*) has been established at what is now called the Shortland Wetlands Centre, Shortland, a suburb of Newcastle, N.S.W., near the edge of Hexham Swamp. Prior to 1970 *E. alba* and *E. intermedia* nested in mangroves on the Walsh Island end of Kooragang Island, but the heronry was destroyed by reclamation for industrial development (Van Gessel, pers. comm.).

Cattle Egrets began breeding at Shortland in trees near the Steelworks Golf Course in the 1979-1980 season, 45 pairs having been recorded, and 85 pairs returned to the same site in 1980-1981, in company with a single pair of Little Egrets (Weber, 1983, pers. comm.). In November 1981, the focus of breeding shifted about 0.5-1.0 km north across Sandgate Road, to a stand of mainly Broad-leafed Melaleuca trees *Melaleuca quinquenervia* in a lagoon at what used to be known locally as Marist Park (32°51′S., 151°42′E.). All four species bred in company with the Little Pied Cormorant *Phalacrocorax melanoleucos*. Three hundred and forty-eight nests were recorded in the 1981-1982 season and this number has expanded each season with 606 nests recorded in 1984-1985, including one nest of the White-faced Heron *Ardea novaehollandiae*. A summary of the nest counts for the four seasons is given in Table. 1.

TABLE 1

Number of nests recorded at Shortland Breeding Colony during the 1981-1982 to 1984-1985 seasons

Species	1981-1982	1982-1983	1983-1984	1984-1985
		Season		
Great Egret *Egretta alba*	30	55	75	84
Little Egret *E. garzetta*	30	27	26	25
Intermediate Egret *E. intermedia*	72	39	91	116
Cattle Egret *Ardeola ibis*	108	243	310	350
Little Pied Cormorant *Phalacrocorax melanoleucos*	108	17	64	30
White-faced Heron *Ardea novaehollandiae*	0	0	0	1
TOTAL	348	381	566	606

Detailed observations have been maintained during the breeding seasons since the establishment of the colony. During the 1982-1983 and the 1983-1984 seasons, a study was made on fledging success of all four species.

METHODS

Trees in the colony were numbered at the beginning of the 1982-1983 season. During each season, nest positions within each tree were marked on a diagram drawn of the tree from a fixed observation point. Each nest was numbered and bird species of the owner was determined. One of the observation points was a hide constructed about three metres above water level in a tree in the centre of a part of the heronry. Nest heights ranged from about 3 m to 10 m above the level of the lagoon. Great Egret nests were generally located at or near the tops of the trees, the other species were scattered throughout the canopy.

Five observers were used during the 1982-1983 season and three during the 1983-1984 season. Trees in the colony were divided up into groups observable from fixed observation points, one of which was the hide, and shared between the observers on a basis of volunteered capacity of the individual observers. The author made observations from the hide on an almost daily basis except for a gap of 2 weeks in January 1983 and 1 week in December 1984. Observations from the other points were made as frequently as the observers were able, usually at least once per week. Detailed observations were compiled on 55 Great, 23 Little, 39 Intermediate and 136 Cattle Egret nests in 1982-1983 and 42 Great, 26 Little, 68 Intermediate and 114 Cattle Egret in 1983-1984. These details were recorded on RAOU nest cards.

The nest contents were observed through binoculars at each visit. In general, because of the placement of nests, and the depth of water which surrounded the trees when incubation was in process, it was not possible to obtain clutch numbers, particularly for the Great Egret nests which occupied topmost positions. Some clutch data were obtained for Little and Intermediate Egrets.

Breeding attempts were classified as known success, probable success, outcome unknown, probable failure, known failure (Table 2). The maximum number of young observed in each nest, and the number fledged in nests classified as successful, were determined. Young were defined as successfully fledged if they were observed flying between nearby branches or nearby trees at the last observation.

During the 1982-1983 and 1983-1984 breeding seasons, reliable recordings of known successful nests and numbers of fledged young in these nests were made for the Great Egret at 32 and 29 nests, for the Little Egret at 15 and 16 nests, for the Intermediate Egret at 20 and 48 nests and for the Cattle Egret at 67 and 71 nests, respectively.

Monthly rainfall figures were obtained from the meteorological stations at the RAAF base at Williamtown (about 20 km northeast of the colony) and the Hunter Valley Research Foundation at Maryville (about 5 km southeast of the colony). Seasonal profiles were compiled, beginning with the 1978-1979 season, dividing the year into the winter period (May-October), the first 3 months of the breeding season (November-January) and the last 3 months (February-April).

Variations between the Maryville and Williamtown figures, together with subjective observations of rainfall at the Shortland colony and other areas during the four breeding seasons, indicate that Shortland has a microclimate of its own, i.e. weather patterns are substantially different between the sites. However, the Maryville

TABLE 2

Summary of the outcomes from breeding attempts in the four species of egret

Species	Season	Nests Colony n	Nests Sample n	Known Success n	Known Success %	Probable Success n	Probable Success %	Outcome Unknown n	Outcome Unknown %	Probable Failure n	Probable Failure %	Known Failure n	Known Failure %
Great Egret	1982-1983	55	55	32	58	11	20	9	16	1	2	2	4
Egretta alba	1983-1984	75	42	29	69	2	5	7	17	0	0	4	10
Little Egret	1982-1983	27	23	15	65	6	26	2	9	0	0	0	0
E. garzetta	1983-1984	26	26	16	62	2	8	4	15	2	8	2	8
Intermediate Egret	1982-1983	39	39	20	51	3	8	12	31	1	3	3	8
E. intermedia	1983-1984	91	68	48	71	4	6	7	10	2	3	7	10
Cattle Egret	1982-1983	243	136	67	49	11	8	56	41	0	0	2	1
Ardeola ibis	1983-1984	310	114	71	62	2	2	38	33	0	0	3	3

n = number

figures give an indication of the likely rainfall at the colony site. The figures from both stations are indicators of the general rainfall levels typical of the lower Hunter Valley area around Lake Macquarie, Maitland, Raymond Terrace and Williamtown, in which the egrets most likely forage for food for their young. Until results from the current patagial tagging programme are forthcoming it is not known what range of feeding areas are used.

RESULTS

Rainfall Profiles

The rainfall profiles from 1979-1980, when Cattle Egrets first bred at the Steelworks Golf Club site at Shortland, through to the breeding season of 1984-1985, are given in Table 3. The 1979-1980 season was towards the end of the long drought period which seriously affected the Hunter Valley, as well as most of eastern Australia. The microclimatic effect can be observed in the 1981-1982 figures as compared with the previous season, with Williamtown and Maryville being reversed. However, with more than 700 mm of precipitation during the 1981-1982 breeding season, as compared with about 600 mm for 1982-1983, it can be classified as a wet season.

The 1981-1982 season, when breeding activity transferred to Marist Park and when all four species commenced breeding together, was the first year in which consistent rain occurred over the 3 months preceding nesting and was maintained through the nesting season. The heronry trees remained standing in water throughout the season. Although detailed individual nest records were not maintained over a large sample of nests, it was evident from general observation that the young reared in the colony tended to remain until well into April (Maddock, 1983).

For 1982-1983, although the 12 months' rainfall (May 1982-April 1983) and the winter fall was a little higher than in 1980-1981, the first 3 months of the nesting season were of similar order of dryness to that in 1979-1980. By January the nest trees were on dry land and the wetlands of the lower Hunter Valley had substantially dried up. Large numbers of duck (including the Freckled Duck), migratory waders, Glossy Ibis and other water birds such as crakes and spoon-

TABLE 3

Rainfall (mm) profile for winter (May-Oct.), early breeding season (Nov.-Jan.) and late breeding season (Feb.-Apr.)

Season		May-Oct.	Nov.-Jan.	Feb.-Apr.	Breeding Season Total	Yearly Total
1979-1980	M	526	105	151	256	782
	W	525	51	27	78	603
1980-1981	M	347	196	381	577	924
	W	301	101	383	484	785
1981-1982	M	447	334	369	703	1 150
	W	511	281	339	620	1 131
1982-1983	M	529	110	480	590	1 119
	W	530	91*	360	441	971
1983-1984	M	479	427	514	941	1 420
	W	445	341*	364	705	1 150
1984-1985	M	370	267 (Jan. 2.4)	182	449	819
	W	363	197 (Jan. 13)	- - not obtained - -		

M = Maryville
W = Williamtown

TABLE 4

Number of young fledged from known successful nests.

Species	Season	1 n	1 %	2 n	2 %	3 n	3 %	4 n	4 %	5 n	5 %	Nests n	M	SD	Chi-sq	df	P<
Great Egret	1982-1983	10	31	19	54	3	9	–	–	–	–	32	1.78	0.61			
Egreta alba	1983-1984	1	3	14	48	14	48	–	–	–	–	29	2.45	0.57			
	Total	11	18	33	54	17	28	–	–	–	–	61	2.09	0.68	14.99	2	0.001
Little Egret	1982-1983	8	53	7	47	–	–	–	–	–	–	15	1.47	0.52			
E. garzetta	1983-1984	1	6	5	31	8	50	2	13	–	–	16	2.69	0.79			
	Total	9	29	12	39	8	26	2	7	–	–	31	2.10	0.91	15.57	2	0.001
Intermediate Egret	1982-1983	2	10	17	85	1	5	–	–	–	–	20	1.95	0.39			
E. intermedia	1983-1984	3	6	22	46	23	48	–	–	–	–	48	2.41	0.61			
	Total	5	7	39	57	24	35		–	–	–	68	2.28	0.59	11.02	2	0.01
Cattle Egret	1982-1983	8	12	14	21	41	61	4	6	–	–	67	2.61	0.78			
Ardeola ibis	1983-1984	2	3	23	32	42	59	4	6	–		71	2.68	0.63			
	Total	10	7	37	27	83	60	8	6	–	–	138	2.64	0.70	4.74	3	0.20(ns)

n = number.

bills, made use of the Shortland area as a drought refuge (Maddock, 1983). Unlike the previous season, the egrets tended to disperse as soon as they fledged.

The 1983-1984 season was consistently wet. Rainfall at the two recording stations was somewhat less than the previous season for the winter, but almost four times as much rain fell during the 3 months from November to January when most egg-laying and chick rearing took place. Good rains continued for the next 3 months and the nest trees remained standing in water for the whole of the breeding season.

The 1984-1985 season was as dry as the 1980-1981 winter and somewhat more severely dry than in 1982-1983 during the breeding season. According to local meteorological reports, January 1985 was the driest month on record, with Maryville recording only 2.4 mm. The whole of the nest colony area dried up as it did in 1982-1983.

Fledging Success

The average number of fledged young egrets per successful nest was calculated for those nests from which reliable results were obtained (Table 4).

The success in fledging young, measured by average young per nest, increased significantly for the Great, Little and Intermediate Egrets in the 1983-1984 (wet) season, compared with the 1982-1983 (dry) season. There was no significant change for Cattle Egrets.

The percentage loss of young from nests observed to successfully fledge young is given in Table 5.

DISCUSSION

The breeding success for what might be called the "water dependent species", which feed mainly on aquatic organisms, namely the Great, Little and Intermediate Egrets, was significantly better in the wet 1983-1984 season than in the dry 1982-1983 season at Shortland in terms of numbers of young fledged in nests known to have successfully raised young. By comparison, the Cattle Egret, which is known to feed predominantly on insects in pasture land in company with livestock showed no significant difference in breeding success between the two seasons.

There are few other studies which can be used for comparison with the Shortland data, and most of these refer to Cattle Egrets. Cramp (1977) cites breeding success figures for the Great Egret in Hungary of 1.13-3.06 over six years. However no information was provided on seasonal climatic factors. The 1982-1983 and 1983-1984 data for Shortland Great Egrets fall within this range. Cramp (1977) quoted no figures for breeding success for the Intermediate Egret or Little Egret.

The breeding success at Shortland for Cattle Egrets appears to be significantly higher in both dry and wet seasons than those obtained in over-

TABLE 5

Loss of young from known successful nests.

Species	Season	Nests n	Young lost from each nest n=1	n=2	Total lost	Total young	% loss
Great Egret *Egreta alba*	1982-1983	32	9	0	9	57	16
	1983-1984	29	5	0	5	71	7
Little Egret *E. garzetta*	1982-1983	15	5	0	5	29	17
	1983-1984	16	2	0	2	45	4
Intermediate Egret *E. intermedia*	1982-1983	20	5	0	5	39	13
	1983-1984	48	2	0	2	94	2
Cattle Egret *Ardeola ibis*	1982-1983	67	8	3	14	175	8
	1983-1984	71	9	4	17	190	9

seas studies. Potyraj and Creighton (1977) reported fledging success for two heronries on the lower South Carolina coast in 1976, of an average of 1.1 per successful nest. Blaker (1969) claimed for the South African colony he studied that he had never observed three or more siblings older than 20 days in one nest, commenting that "it must be uncommon".

Blaker (1969) reported that growth rates of young cattle egrets are chiefly dependent of the relative ages of the chicks, with the majority of third and fourth hatched chicks dying before 15 days. In his observations of 12 three-chick nests, only one each of the first and second hatched chicks died, whereas 11 of the 12 youngest chicks died within 7-17 days.

Siegfried (1972a) stated that the normal clutch and hatch for Cattle Egrets in the South African colonies in his studies was three, but that there was seldom success in raising more than two.

In discussing the discrepancy between clutch size and fledging outcome he stated:

> . . . why should the average clutch size not correspond more closely to the average number of young reared per brood? Preliminary observations indicate that environmental conditions in the study area during the breeding season are not so unpredictable and variable from year to year that they could favour a mechanism which would permit a disproportionately large average clutch size to correspond to ultra-favourable environmental conditions, which might occur often enough to yield significantly increased productivity. In short, there seems to be no advantage attached to southwestern Cape Cattle Egrets maintaining a clutch size above the normal optimum needed to correspond to the relatively stable and predictable food resources available for feeding the young.
>
> (Siegfried, 1972a, p. 204)

In the only Australian study available, McKilligan (1985) obtained very similar figures to those obtained in this one. In a study of breeding success of Cattle Egrets in Queensland over 3 years (1978-1980 to 1980-1981) he obtained a value of 2.6 for the average number of fledglings produced from successful nests.

Lack (1954) put forward the theory that asynchronous hatching is a mechanism which permits adjustment of brood size in response to unpredictable fluctuations in food availability.

Field observations in Shortland over the four breeding seasons, coupled with data obtained during banding operations in the 1984-1985 season, confirm that all four species follow the pattern of asynchronous hatching reported in the literature for egrets, with considerable variations in weight and stages of feathering. However, the author has observed numerous three-chick nests surviving beyond 20 days for all four species (see Table 4).

In the case of Cattle Egrets, the figure did not vary significantly over the dry and wet seasons (with 61% of known successful nests in 1982-1983 and 59% in 1983-1984 successfully fledging three young and 6% in each of these two seasons fledging four young). One successful nest of five chicks was recorded in 1981-1982, and one nest which eventually fledged four young was observed to have five healthy chicks until shortly before fledging in 1984-1985 (dry season).

However, with Great, Little and Intermediate Egrets, the figures varied significantly between the dry and wet seasons. For the Great Egret only nine percent of successful nests fledged three chicks in 1982-1983, compared with 48 percent in 1983-1984. One nest recorded in 1981-1982 (wet season) successfully raised four chicks and one nest in 1984-1985 (dry) had four healthy well-feathered chicks until beyond 20 days. In this latter case, however, the fourth chick disappeared about 2 weeks before fledging.

For the Little Egret, no nests of three chicks were recorded in 1982-1983, but in the wet 1983-1984 season, 50 per cent successfully fledged three and 13 percent fledged four young. Comparable data for the Intermediate Egret were five percent in 1982-1983 and 48 percent in 1983-1984.

Unfortunately, insufficient data have been gathered on clutch sizes at Shortland for the four species in order to make conclusive inferences on whether the average clutch size changes with season, thus affecting fledging success. Nevertheless subjective observations over the seasons combined with the clutch size data available, suggests that it does not vary significantly. Williams (1984, pers. comm.) observed numerous clutches of five eggs for both Great and Intermediate Egrets at the Kooragang Island colony before it was destroyed, about 1970, but only one clutch of four has been recorded for the Intermediate Egret at Shortland, and most observations where eggs have been seen in nests suggest that three eggs is more the norm for both Great and Intermediate Egrets.

It is the author's hypothesis that the relationship between seasonal food availability and lethal aggression between siblings is the critical factor at work in determining breeding success. Mock (1982) proposed that a rigid linear pecking order develops in Great Egret nests, monopolized by the elders, with about one-third of all third hatched chicks dying. Detailed observations carried out on two Great Egret nests at Shortland, where this linear pecking order was clearly evident, are compatible with this theory. In both cases, as the birds became well feathered, the third chick was severely pecked and driven away from parents at feeding time, and in one case, "Number three" would respond by crouching low at the edge of the nest and hanging head and neck vertically downwards. In each case, the third one died and only two chicks were successfully fledged.

No equivalent behaviour has been specifically observed for Little, Intermediate or Cattle Egrets, but cases have been observed where the smallest young failed to receive food during feeding visits by parents. Data have not yet been fully analyzed for the 1984-1985 season (during the latter part of which the lagoon dried out rapidly) but a number of cases were recorded in which the smallest siblings which reached fledging stage during February, in Little and Intermediate Egret nests, failed to survive. Further work using marked nestlings needs to be carried out to define the patterns of parental feeding and inter-sibling aggression patterns.

Some work has been started at Shortland on the food supplied to the young by parents. Preliminary data obtained in 1984-1985 support findings made elsewhere that Orthopteran insects (grasshoppers and field crickets) form the bulk of the diet fed to Cattle Egret chicks. McKilligan (1984) reported that Orthoptera comprised 68 to 84 percent by number and 50 to 64 percent by weight of the food of Cattle Egret young studied at Gatton in Queensland. Comparable figures from South Africa were Orthoptera 78 percent and 56 percent respectively (Siegfried, 1966). Siegfried (1972a) estimated that each Cattle Egret parent must capture 1 728 grasshoppers in a 12 hour day to maintain itself and its young.

Between the end of January 1985 (the driest January on record) and the end of February, when most small swamplands in the lower Hunter Valley, including the colony site, had become dry, regurgitated bolus material from Cattle Egret nestlings being banded predominantly consisted of grasshoppers and crickets, with a small number (but relatively high proportion by weight) of the skink lizards (*Lampropholis delicata* and *L. mustelina*). However, regurgitations from Little and Intermediate Egret nestlings contained mainly small fish (*Gambusia affinis* and *Hypseleotris galii*) in early February. No late February data are available for the Little Egrets, but the bolus material then obtained from Intermediate Egrets had changed to predominantly grasshoppers and skinks, in very similar proportions to those obtained from Cattle Egrets. During this period signs of stress were observed in Intermediate Egret broods, with many deaths of younger siblings, and in the case of two nests, leg deformities.

No bolus material was obtained directly from Great Egrets, but material collected from the colony floor contained large fish (as long as 20 mm) such as mullet (species not identified) and fragments of eels of unidentified species. Fish of substantial size (much longer than 20 mm) were observed being fed to young in the nests.

These preliminary observations suggest that for Cattle Egrets the available insect food from pastures and the availability of feeding areas do not vary significantly between dry and wet seasons, and hence this species has the capacity to more successfully cope with seasonal change. In the case of Intermediate Egrets, dry season breeding success is lower than wet season (a decrease in average fledged per nest by about 19% between 1982-1983 and 1983-1984 at Shortland). However, there is evidence to suggest that this species is able to make an adjustment in diet patterns by switching from aquatic organisms, which become unavailable as wetlands dry up, to a diet of pasture insects and reptiles similar to that eaten by Cattle Egrets.

In the case of the Great Egret, breeding success, measured by average number of young fledged per successful nest, was less by about 27 percent in the dry 1982-1983 season compared with the wet 1983-1984 season. Observations suggest that this species largely depends on fish and larger crustaceans such as crabs. Material collected from the floor of the colony during the severe dry part of the 1984-1985 season indicates that the fish and crabs most likely came from the nearby Hunter River Estuary. It is hypothesized that in a wet season, a wider range of freshwater and estuarine habitat is available to support this species than in a dry season, when estuarine feeding habitats provide the main food source.

It is also hypothesized that the Little Egret is most severely affected by seasonal changes in rainfall. The breeding success at Shortland for this species was 65 percent lower during 1982-1983 than 1983-1984. It is suspected that the Little Egret is more heavily dependent on freshwater wetland habitat than the other two "water-dependent" species.

To investigate the hypotheses raised here, further studies need to be carried out using wing-tagged or banded adults and marked nestlings, with observations carried out throughout the feeding range of the adults and at the nest-sites during the breeding season. Automatic-recording meteorological equipment is being set up at the colony to complement climatic data from Maryville and Williamtown, to clarify the micro-climatic factors. A comprehensive banding and tagging programme is to be continued at Shortland to enable the gathering of more detailed data on the feeding patterns of adults and on specific nest behaviour related to the feeding and survival of the young.

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REFERENCES

Blaker, D. (1969). Behaviour of the Cattle Egret, *Ardeola ibis*. *Ostrich* 40: 75-129.

Cramp, S. C. (Ed.) (1977). Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. London: Oxford University Press.

Lack, D. (1954). The natural regulation of animal numbers. London: Oxford University Press.

McKilligan, N. G. (1984). The food and feeding ecology of the Cattle Egret, *Ardeola ibis*, when nesting in south-east Queensland. *Aust. Wildl. Res.* 11: 133-44.

McKilligan, N. G. (1985). The breeding success of the Indian Cattle Egret (*Ardeola ibis*) in eastern Australia. *Ibis*. 127: 530-536.

Maddock, M. N. (1983). Hunter Valley birds raise conservation issues. *Wetlands (Australia)* 3 (2): 71-80.

Mock, D. W. (1982). Brood reduction in herons: The siblicide threshold hypothesis. *Colonial Waterbirds* 5: 57.

Potyraj, J. J. and Creighton, P. D. (1977). Breeding success and nesting growth of the Cattle Egret (*Bubulcus ibis*). Proceedings of 1977 Conference of the Colonial Waterbird Group. Northern Illinois University.

Siegfried, W. R. (1972a). Food requirements and growth of cattle egrets in South Africa. *The Living Bird*: 193-206.

Siegfried, W. R. (1972b). Breeding success and reproductive output of the Cattle Egret. *Ostrich* 43: 43-55.