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BREEDING OF THE SLATY EGRET *EGRETTA VINACEIGULA* ALONG THE BORO RIVER IN THE CENTRAL OKAVANGO DELTA (BOTSWANA)

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SUMMARY

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Slaty Egrets *Egretta vinaceigula* were found breeding in a mixed heronry with Rufousbellied Herons *Butorides rufiventris* in a reedbed on the Boro River in the central Okavango Delta. Breeding occurred in 1988, 1989 and again in 1992 after the reedbed had recovered from fire and reed-cutting. There was no breeding in this area in 1990, 1991 and 1993. It is estimated that 50 pairs of Slaty Egrets were present in 1988 and 1992 and 60 in 1989. Breeding started in May or early June, close to peak flood levels. Breeding success of Slaty Egrets was low: *c.* 30% in 1988 and 1989 while all eggs were preyed upon in 1992, giving an overall success of *c.* 10% for the six years. During the six years, the reedbed was the only site used for breeding by Slaty Egrets in 75 km of floodplain along the Boro River (no alternative site was used in 1990, 1991 or 1993) and differences in quality of the reeds (mainly as a result of fire history) suggest that it was the only suitable site.

INTRODUCTION

The Slaty Egret *Egretta vinaceigula* was recognized as a valid species only 22 years ago (Benson *et al.* 1971). Most aspects of the biology of this relict species, the distribution of which is concentrated in the swamps of northern Botswana and Zambia (Dowsett 1981), are still little known. The first indication of breeding was provided by G. Wilson & M. Waltner in May 1971 when eight pairs were found nesting in a dense reedbed along the Chobe River in northern Botswana (Benson *et al.* 1971). Two other breeding records have been documented from Botswana. Dowsett (1981) found a single nest in *Ficus verruculosa* thickets in the north-eastern part of the Okavango in June 1975, and Fry *et al.* (1986) found *c.* 30-35 active nests at the same site in March 1985 in a mixed colony with Rufousbellied Herons *Butorides rufiventris*. Recently, breeding was suspected in dense reeds in permanent wetlands and two colonies were reported from temporary wetlands in northern Namibia (Hines 1992).

Slaty Egrets are widespread in the Okavango Delta in Botswana (Collar & Stuart 1985) and common towards the centre of the delta (Dryden 1982; Fothergill 1982; 1983a, 1983b; Randall 1990), which probably constitutes a core area of its distribution. This paper reports on the first Slaty Egret breeding records in the central Okavango where a large mixed colony with Rufousbellied Herons was studied in 1988, 1989 and 1992.

STUDY SITE

The heronry was situated in *c.* 1,5 ha of *Phragmites australis*-reeds some 7 km upstream from Xaxaba in the Jugujugu area along the Boro River (19 30.41 S, 23 01.47 E). Breeding coincided with high flood levels, and the reeds were in several feet of water during the breeding season. Access to the reedbed was only possible by mokoro or small boat along a few small tracks. From these tracks, it was possible to survey some 40% of the total reedbed. Breeding of Slaty Egrets and Rufousbellied Herons was first noted in 1988 and the colony was also occupied in 1989. No breeding occurred in 1990 when the site was destroyed by a fire or in 1991 when it was affected by illegal reed cutting. Breeding resumed again in 1992, after the reedbed had recovered. The reedbed was untouched in 1993, but no breeding had started by mid July. The reedbed was the largest and most mature in the area, with high reeds at high density. Two thirds of the site were extensively overgrown with the creepers *Vigna luteola* and *Mikania cordata*.

METHODS

Most of the upper Boro region was visited regularly by RR during his residence in the area since 1986. Potential breeding sites and sites used by Slaty Egrets to roost were monitored more closely for breeding activity.

During each breeding season the heronry was visited almost weekly and notes were made on the total number of birds of both heron species flying out of the reedbed and returning afterwards. Nests were mapped and nest contents noted, but it was sometimes difficult to relocate nests during subsequent visits. In contrast to the findings by Fry *et al.* (1986), there was no difference in the nest structure between Slaty Egrets and Rufousbellied Herons at this site and, consequently, early in the breeding season nests could only be assigned to species when the adults were seen. However, Slaty Egrets are considerably shyer than Rufousbellied Herons and it was, therefore, more difficult to identify Slaty Egret nests. From a sample of identified nests, it was found that Slaty Egrets had slightly larger eggs (see below) and several more nests were later identified by the size of the eggs. Later in the breeding cycle, differences between the chicks of Slaty Egret and Rufousbellied Heron (Fry *et al.* 1986) were also used to identify nests. Due to the very difficult con-

ditions in the reed bed, it was impossible to collect full information from all nests at all visits. It was therefore not possible to calculate breeding success accurately.

Characteristics of the only three reedbeds larger than 1 ha along the Boro River were measured during mid June 1992. At each site, six one meter square quadrants were randomly chosen. In each quadrant reed density was estimated, the height and the diameter of 25 randomly selected reed stems was measured, the status of the reed (living or dead) and the presence or absence of creepers was noted.

RESULTS

Breeding season & flood levels

Breeding started just before peak flood levels in the years with typical seasonal floods generated by inflow from the Okavango River (1988, 1992), but just after peak water levels in 1989 when the floods were advanced and boosted by abundant local rains. In 1988 Slaty Egrets and Rufousbellied Herons started nest building in the last week of May, but in 1989 - a year of early and above average flood levels - nests were constructed at the beginning of May and the first eggs were seen on 13 May. Breeding was again later in 1992, with nest building after mid May and several eggs present on 1 June (Figure 1). The floods in the Okavango were poor and very late in 1993 with water levels along the Boro *c.* 0,70 m below the 1992 level by mid July, but still slowly rising. No breeding of Slaty Egrets had started by mid July in 1993 and the reedbed was only used by two dozen Slaty Egrets to roost at night.

Breeding numbers

The maximal number of adults flushed from, or returning to, the colony during the weekly visits and the number of nests found and estimated are given in Table 1. Assuming that all adults attending the colony were breeding, c. 50-60 pairs of Slaty Egrets may have nested in the reedbed during each of the three years when breeding occurred.

Nest position, size & structure

All characteristics of nests in the mixed heronry varied, but no bimodality was detected, indicating that no consistent differences existed between nests of Slaty Egrets and Rufousbellied Herons at this site. No statistical differences were found between the samples of nests identified to species.

Nests were 0,5-1,7m above the water and invariably rested on fallen reeds (Mean=1,15 m, SD=0,3 m, N=21). Nest sizes (N=23) ranged between 19-41 cm (diameter) x 16-22 cm (depth). Nests in the zone of the reedbed where creepers occurred contained predominantly dry pieces of creeper (71-91%, N=6) on a base of reeds and were on average considerably more elaborate (median number of pieces >5cm = 462). Nests away from creepers contained >94% of reeds (N=3) and were built with less material (median number of pieces >5cm = 281; Mann-Whitney-U test: $P<0,05$). The creepers were also used to "attach" the nests to the supportive or adjacent reeds, making them stronger and more stable platforms than the nests predominantly built with reeds in the other part of the reedbed. It is tempting to believe that "reed" and "creeper" nests were each built by a different heron species, but observations of adults attending the nests in different parts of the reedbed indicated that this was not the case. Only five small wooden branches were found in 10 nests analysed, further indicating that most nesting material was collected close to the nest. However, the presence of some creepers in the "reed"-nests, away from where creepers occur, indicates a slight preference to nest with creepers. All the nests in the reedbed also contained reed panicles (1-13 per nest in the ten nests analysed), mostly as lining of the nest cup.

Eggs and incubation

The average clutch size was 3,1 eggs. Most nests of Slaty Egrets had 3 eggs (N=21). Clutches of 4 (N=11) and 2 (N=6) were less common. One nest had a single egg, but part of the clutch might have been lost. Slaty Egret eggs measured slightly larger (39-43 x 30,5-32; $\bar{X}$ 41,05 x 31,14, N=31) than eggs of Rufousbellied Herons, which in several cases allowed identification of nests on the basis of egg size.

Only one nest was documented from first egg laid (13 May 1989) to first date of first chick seen (4 June). However, the chick could already have hatched as early as 2 June, giving an incubation time of 21-23 days.

Breeding success

During 1988 and 1989, 31 nests of Slaty Egrets

TABLE 1
NUMBERS OF SLATY EGRETS AND RUFOUSBELLIED HERONS IN A MIXED HERONRY UPSTREAM FROM XAXABA IN THE JUGUJUGU AREA (CENTRAL OKAVANGO, BOTSWANA).

		1988	1989	1992
Slaty Egret	Adults seen	102	118	*c.*100
	Nests found	21	24	3
	Total nests estimated	50	60	50
Rufousbellied Heron	Adults seen	98	116	*c.*100
	Nests found	17	26	5
	Total nests estimated	50	60	50
Unidentified	Nests found	12	20	37

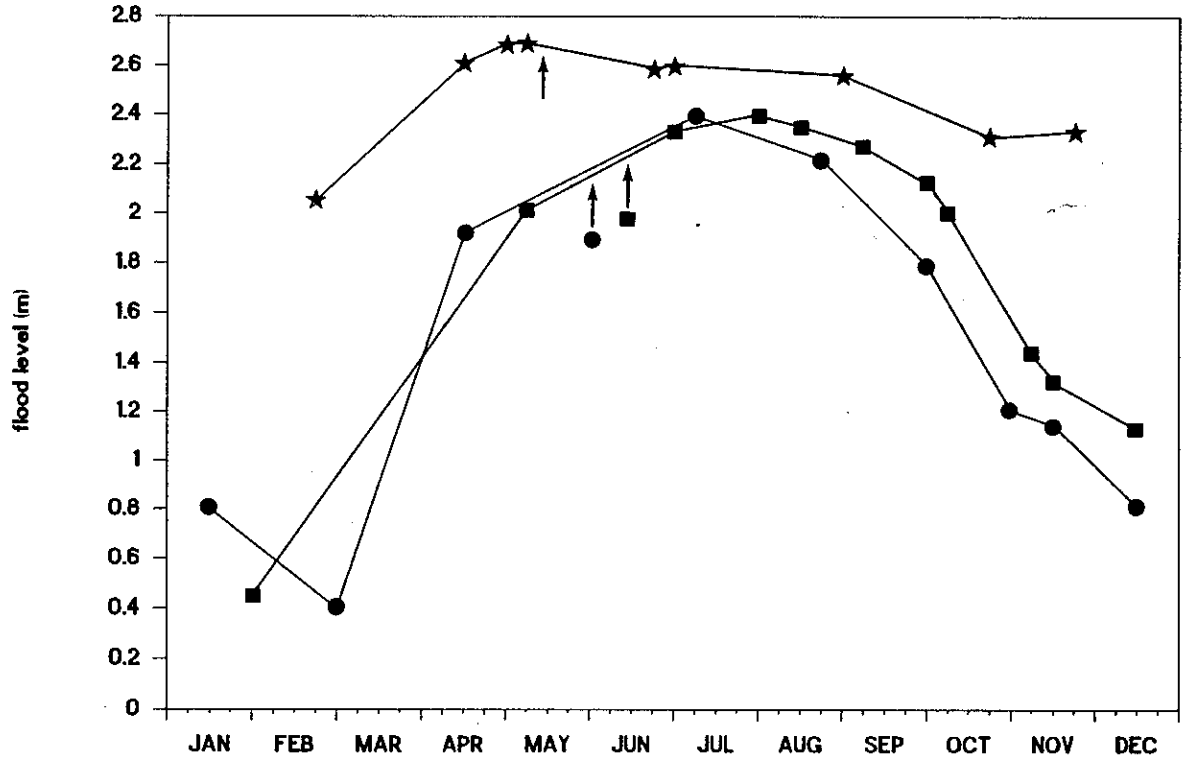

FIGURE 1

Seasonality of flood levels (at Kakue) and initiation of breeding of Slaty Egrets along the Boro River in the Jugujugu area (central Okavango, Botswana). Arrows indicate date of first eggs in the colony.
■ 1988, ★ 1989, ● 1992

were followed for breeding success. Hatching success was *c.* 50% and two weeks after hatching only a single nestling was left on average in each nest. When just over a week some nestlings were seen on reeds up to 40 cm from the nest. Forty days after hatching there were no juvenile Slaty Egrets in the reedbed, whilst juveniles were seen perched on trees in the vicinity. It is estimated that no more than 30% of the eggs laid resulted in fledged young in 1988 and 1989.

During 1992, the first eggs were found on 1 June, but by 6 June *c.* 10 % of the clutches had been lost to predators. Two weeks after the start of breeding all clutches were lost and no eggs hatched in 1992. Ten nests analysed for nesting material all contained pieces of egg-shell and two nests were covered with blood and feathers indicating that adults were also killed on the nest. After the colony was decimated, only some 40 Slaty Egrets and 25 Rufousbellied Herons returned to the reedbed to roost at night, but no replacement clutches were started.

In 1988 and 1989 a small number of fledglings was killed on leaving the nest, either by being impaled on broken, sharp reedstems or by inextricably wedging their necks between two stout reeds. Potential predators of eggs and chicks regularly observed in the colony over the years were Black Crake *Amaurornis flavirostris*, African Marsh Harrier *Circus ranivorus*, African python *Python sebae* and water monitor *Varanus niloticus*. Excreta found in some nests in 1992 indicate that water mongooses *Atilax paludinosus* were predators of both eggs and adult birds. Several Hamerkop *Scopus umbretta* persistently entered the reedbed during the day and are also suspected to have taken eggs.

Immature plumage

Hines (1992) described the immature plumage of the Slaty Egret, but contrary to his observations, in our experience, immatures have the buffy pink to pale brown not restricted to the throat and upper breast, but extending further down to the belly.

Choice of the breeding site

Potential breeding sites for Slaty Egrets are few along the Boro River. There are no thickets of *Ficus verruculosa* and only a few large reedbeds, the morphology of which is variable, mainly according to the recent fire history. In 1992, only three reedbeds of more than 1 ha were present between Tchau (25 km upstream from Xaxaba) and Diadura (50 km downstream from Xaxaba), i.e. along 75 km of floodplain. Only the breeding site had fully mature reeds (mean length=2,8±1,15 m, max=6,5 m) at high density (mean=85±15 stems/m^2), with a high proportion of old, dead and dry reeds (70%) and many stems supporting

creepers (33%). The whole reedbed was densely covered by panicles, illustrating its mature growth-stage. The reedbed at Tchau was slowly recovering from almost chronic fire damage which is reflected in the poor quality of the reeds. It was less dense (mean=60±12 stems/m^2; t-test: P<0,005) and reeds were smaller (mean=2,4±0,8, max=4,5 m; t-test: P<0,01). Creepers were similarly common (26%; $\chi^2_{df=1}$=1,93: NS), but less of the reeds were dry (51%; $\chi^2_{df=1}$=12,8: P<0.0001). The reedbed opposite Xaxaba camp was still recovering from a fire in 1990: rather few panicles were present and most were overgrown by the new, stronger reeds. The density (mean=78±33 stems/m^2; Mann-Whitney U-test: NS) and height (mean=2,8±1,0 m; t-test: NS) of the reeds were similar to the breeding site, but there were no creepers at all (0%; $\chi^2_{df=1}$=60: P<0,0001) and much less dry reeds (39%; $\chi^2_{df=1}$=30.1: P<<0,0001). Downstream from Xaxaba, there is an area between 19 32 S/23 07 E and 19 37 S/23 13 E with a concentration of more than a dozen of reedbeds varying from small strips to medium size. Except for rather narrow zones bordering the channels, these sites had mainly short, open reeds in shallow water with insignificant presence of creepers. Only Purple Herons *Ardea purpurea* have been recorded breeding in this area. Several more places along the Boro River had reedbeds in the early eighties, but all have been destroyed, damaged or much reduced by fire recently.

DISCUSSION

The upper Boro River has extensive areas of shallow floodplains with low grassy or aquatic vegetation, which is recognized as prime feeding habitat of Slaty Egrets (Vernon 1971; Milewski 1976; Dowsett 1981; Dryden 1982; Mathews & McQuaid 1983; Hines 1992). The species is common to abundant (*sensu* Brown *et al.* 1982) in this area which covers roughly 10% of the swamps in the Okavango Delta, but this report is the first breeding documented from the region. Potential breeding sites for Slaty Egrets are few along the Boro River. There are no *Ficus*-thickets, most extensively used elsewhere in the Okavango Delta as breeding sites by various herons, egrets and storks (Berry 1968; Steyn 1970; Fraser 1971; Child 1972; Fothergill 1983b; Fry *et al.* 1986; Newman 1989). Reedbeds seem the only suitable alternative, but over the last six years, only one reedbed was used. This was the largest of the area with the most dense and mature reeds, extensively infested with creepers. In two years when the quality of the reeds at this site was affected by fire and reed-cutting, breeding was not attempted at all. The reedbed at Xaxaba has been extensively used as a roost by a variety of herons and egrets for several years (Randall 1990), but no breeding occurred here despite the reeds being dense and high. The absence of creepers from this reedbed might be crucial. Availability of suitable breeding sites apparently constitutes a constraint for the Slaty Egret along the Boro. However, extensive reedbeds are still present further upstream (Jao and Xo) in the centre of the Okavango where more breeding sites of Slaty Egrets might be present. Reduction of potential breeding sites for Slaty Egrets by reed-cutting and particularly fire is obvious in many parts of the Okavango Delta and along the Linyanti and Chobe Rivers. The majority of fires are caused by humans and the practice is increasing.

Initiation of breeding just before peak flood levels is probably critical to provide physical protection to the colony and optimal feeding conditions during chick rearing. Receding water-levels are preferred by Slaty Egrets (Vernon 1971; Mathews & McQuaid 1983) and dropping water levels after the seasonal flooding make an abundance of young fish brood, the main food for Slaty Egrets in seasonal wetlands (Dowsett 1981; Mathews & McQuaid 1983) more easily accessible. The fact that no replacement clutches were produced after the whole colony was wrecked early in the breeding cycle in 1992, might have been because the critical period to start breeding had passed. The late and slow rising floods in the central Okavango in 1993 might have been too weak and too late to trigger breeding. It is noteworthy that breeding in temporary wetlands in Namibia started in early March, after peak rains and close to maximal flooding (Hines 1992). Several recently fledged Slaty Egrets were observed from early July 1993 onwards in the Chobe floodplains between Kabulabula Lagoon and Kasane, after an exceptionally high peak flood during late May. Breeding of Slaty Egrets along the Chobe might have started in late April or early May in 1993, during rapidly rising water levels.

The position of the nests in the reeds agrees with the observations of Slaty Egret nests in reeds along the Chobe (*c.* 1 m; Benson *et al.* 1971) but is lower than found for Slaty Egrets in *Ficus*-thickets (1-2,5m: Dowsett 1981; Fry *et al.* 1986) or *Acacia*-thickets (Hines 1992). The nest position of Slaty Egrets in reeds is rather similar to the nest position reported from Rufousbellied Herons in thickets (0,5-1,5m: Fry *et al.* 1986). Some of these differences can, however, be the result of still rising water levels after nests were constructed in the reeds.

The results from nests predominantly built with creepers or reeds within the same reedbed indicate that Slaty Egrets collect nesting material close to the nest. Nests in trees are therefore likely to be built with twigs, as reported by Fry *et al.* (1986) and Hines (1992). However, Fry *et al.* (1986) found that in the same mixed colony Slaty Egrets had exclusively used twigs while Rufousbellied Herons had all used reeds. No such differences in nest structure were found between the species during this study, which made data collecting more difficult. Fry *et al.* (1986) reported the longest twigs used in nests as 50 cm, but we found the nests in the reedbed to contain on average 3% of all items over 60 cm long (the longest up to 1,35m).

The breeding success of the Slaty Egret is of considerable concern. Along the Boro, It was comparatively poor (30%) during two years and failed completely because of predation in a third year of breeding. Furthermore, there was no attempt to breed in two other years because of human interference and in one more year possibly because of the poor floods. The overall breeding success of the Slaty Egrets along the Boro for the six years was *c.* 10%. Hines (1992) also reported low breeding success (*c.* 8%) due to predation in Slaty Egrets in Namibia. Related small ardeids normally achieve 50-80% breeding success, but disastrous breeding with almost total failure is not infrequent in Ardeidae (Brown *et al.* 1982; Hancock & Kushlan 1984, Frederick & Collopy 1989; Wallace *et al.* 1992).

Human impact on an already limited number of potential breeding sites in this part of the Okavango in Botswana and the apparently low breeding success of the species suggests that the Slaty Egret might, indeed, better be moved from the "indeterminate" threatened status (Collar & Stuart 1985) to the "endangered" status (Dowsett 1981).

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