

Aspects of breeding biology of Cattle Egret *Bubulcus ibis* in a Grosseto province colony (Tuscany, central Italy)

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Abstract – In this paper we have studied a heron colony near a small artificial lake in Grosseto province (Tuscany, central Italy) during 2004, 2005 and 2006. The colony was almost mono specific (*Bubulcus ibis* 94.9%; *Egretta garzetta* 3.1%; *Ardea cinerea* 1.2%; *Ardeola ralloides* 0.8%) and was settled in a flooded area inside a thick willow wood; therefore we had to adopt a non invasive census method (perimeter count) in order to avoid an excessive disturbance to the nesting pairs. The nesting pairs of Cattle Egret increased from 106 in 2004, to 240 in 2006. A similar increase was recorded also for the other three species. The whole population of the colony (nesting and non nesting birds) grew from a total of 390 herons in July 2004 to 860 in July 2006. In spite of this increase of colony population, the wood area occupied by nesting birds did not increase: it was 0.90 ha in 2004, 2005 and 0.87 ha in 2006, while the number of trees with nests increased from 54 in 2004 to 86 in 2006. Moreover the mean number of nests per occupied tree increased from 2.06 ± 1.69 (range = 1-9) in 2004 to 2.94 ± 2.85 (range = 1-20) in 2006, showing a tendency to an increased crowding, even if the total wood area theoretically available for the colony was about 8 ha. Cattle Egrets started nest building at the beginning of April; onset of laying was estimated on 21 sample nests between 10 and 15 April; about 80% of those pairs were incubating their eggs between 7 and 25 May. After 15 June there were no more sample nests with birds incubating; hatching started between 7 and 25 May; at 9 June 68% of broods were already hatched. At the end of July all newborn Cattle Egrets were fledged. These data allowed us to estimate the average length of the incubation period in 23.8 days. The mean number of hatched Cattle Egrets per nest was 2.5 ± 0.95 (range = 1-5; $N = 34$) the average fledging success was 2.2 fledglings/nest, a value relatively high if compared to the bibliographic data.

INTRODUCTION

Nesting of colonial herons has been reported in 19 different sites in Tuscany (central Italy), eight of these heronries are mixed colonies populated also by Cattle Egrets *Bubulcus ibis*. In two colonies (one is the subject of our work) Cattle Egret is the most abundant species (Centro Ornitologico Toscano 2005, unpublished report). Grosseto province hosts three heronries, which are all populated also by Cattle Egrets.

It is well known that the Cattle Egret has expanded its breeding range worldwide since the beginning of the 20th century (Cramp 1980; Bull and Farrand 2000) and, after a first record in Sardinia in 1985, its breeding population has progressively increased in Italy too (Brichetti and Grussu 1992). In Tuscany the first breeding was recorded in 1997 (Scoccianti and Tinarelli 1999) and for Grosseto province it was reported in 1999 (Giovacchini *et al.* 2001). Cattle Egret population in Tuscany increased to 361 breeding pairs in 2005 (Centro Ornitologico Toscano 2005, unpub-

lished report). Despite its expansion of breeding range and increase in number, data about the breeding biology and reproductive success are quite scarce for Europe, if compared with those outside Western Palearctic. Even fewer data are available for the birds nesting in Italy, although Cattle Egret is species listed as Vulnerable under IUCN criteria (LIPU and WWF 1999).

In this paper we present some data on the breeding biology, nesting success, early chick survivorship and population trend of the Cattle Egret in a central Italy colony.

STUDY SITE AND METHODS

The study area is located near Perotto Lake (Grosseto province, Tuscany) at 11°15' E - 42°36' N (altitude 79 m a.s.l.) in a flooded wood of about 8 ha (total surface), with trees belonging to only *Salix alba*. The tree height ranges from 6 to 14 metres above ground level. The lake is an artificial basin made up by a barrage, where water is used for

irrigating fields; therefore water level rises during winter and falls progressively during summer; as a consequence the willow wood is flooded in winter and is progressively drained during summer: at the end of August all the wood is completely dry. The active nesting area - measured directly at the end of the breeding season - covered about 0.9 ha and was occupied by Cattle Egrets (dominant species), Little Egrets *Egretta garzetta*, a few pairs of Grey Heron *Ardea cinerea* and Squacco Heron *Ardeola ralloides*. In the same willow wood Cattle Egrets roost from November until end of August, so that during the breeding season the colony is composed by nesting and non nesting (roosting) birds. The Perotto Lake heronry was first discovered in 2003, but we presume that Cattle Egrets nested there for the first time between 2000 and 2002.

We decided to monitor the colony using only non invasive methods, therefore all the investigations were made avoiding any disturbance to the nesting pairs. The reason of this choice was the particular characteristic of the heronry, where the nests are built in a restricted area and quite close to water, so that repetitive boat trips inside the colony might be source of intolerable disturbance, which might in turn affect negatively the breeding success.

The census of all heron population (nesting and non nesting) was performed three times by perimeter counts during the breeding seasons 2004, 2005 and 2006 at the end of May, June and July. Two groups of three observers were placed in vantage points on the two sides of the colony. Starting three hours before sunset they counted first the herons perched in the colony and then they counted all the incoming and outgoing birds. The count stopped one hour after sunset. The result of algebraic sum of incoming (added) and outgoing (subtracted) birds was added to the initial count. The average of the results obtained by the two groups of observers represented the total population of the heronry (the two separate counts never differed by more than 3%). The perimeter count is a relatively less precise technique for censusing herons, but it allowed us to avoid any disturbance of the colony.

As the thickness of the willow wood didn't allow a nest count from outside the colony, at the end of each breeding season (in September 2004, 2005 and 2006) we counted all the nests of the colony walking inside the dried wood. Each tree was marked and the number of nests per tree was recorded. The height of the nests from the ground was measured along with the maximum water level in spring (easily readable on the trunk of the trees). The nests of Grey Herons were easily recognizable for their dimensions and their number was confirmed by the number of pairs censused; in June 2006 two Squacco Heron nests were observed with spotting scopes. Since the colony is almost monospecific,

nest height and nest density parameters are affected by a negligible error if referred to Cattle egret (the most abundant species).

At the end of February, before the beginning of a new breeding season, we carefully surveyed all the flooded wood employing two kayaks. We did not find any old nest nor remains of old nests on the trees; therefore we are sure that our September nest counts are reliable and represent only the fresh nests built in the last breeding season. It is possible that our results are slightly underestimated, because we found that a small percentage of Cattle Egret nests falls off (see results below). This slight underestimation - if present - is presumably the same for all the three years considered, therefore it should not have influenced the comparison of the results between years. During the breeding seasons 2005 and 2006 we monitored regularly (every ten days) a sample of 21 Cattle Egret nests, watching them for 4 hours from vantage points, high enough to observe the highest nests. The nests were recognized using reference points, taking photos and marking the trail where the observation points were placed. During the observation period we lost some sample nests (fallen or covered by foliage), therefore the sample was reduced to 19 for 2005 and to 18 for 2006. The following parameters were recorded: nesting phase, number of pulli per nest, mortality, predation, number of fledged young (aged more than 25 days), eggs in the nest (when possible). The average incubation period was estimated calculating the difference between the median time values of the nests-with-eggs and the nests-with-pulli distribution (see Fig. 1 and Fig. 2). All the observations were made with 10x50 binoculars, 20-60x85 Zeiss FL and 20-60x80 Svarowski HD spotting scopes.

RESULTS

The population of each species (nesting and non nesting birds) and the number of nests found in Perotto Lake heronry increased gradually from 2004 to 2006 (Tab. 1 and Tab. 2). The active nesting area was almost stable, covering 0.90 ha in 2004-2005 and 0.87 in 2006, while the number of trees with nests increased from 54 in 2004 and 2005 to 86 in 2006. The average number of nests per occupied tree increased from 2.06 to 2.94 (Tab. 2; Kruskal-Wallis test: $H_c = 7.34$; $P = 0.05$). The average water level under the heronry (referred to the beginning of breeding season) was 2 m for the three years, therefore the average heights of nests above water was 4.69, 5.06 and 5.27 m (Tab. 2; Kruskal-Wallis test: $H_c = 7.39$; $P < 0.05$). We found a wider range of nest heights from 2004 to 2006 with a shift towards the highest tree sites: in 2004 there

Aspects of breeding biology of Cattle Egret in a Grosseto province colony

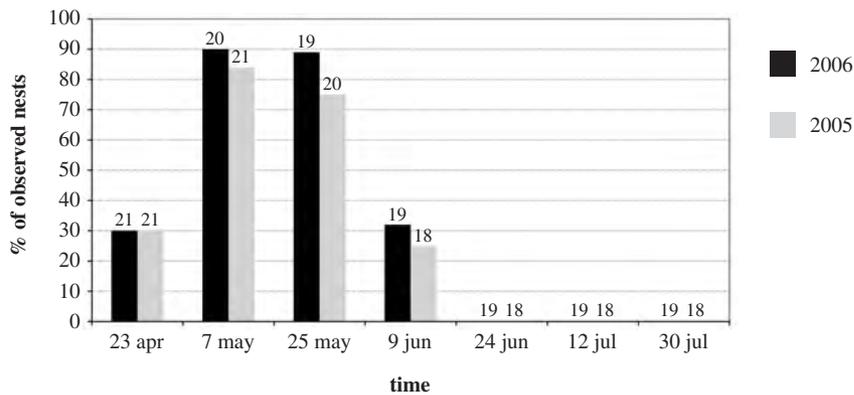


Figure 1. Percent of Cattle Egret nests with eggs; above each column is given the number of sample nests.

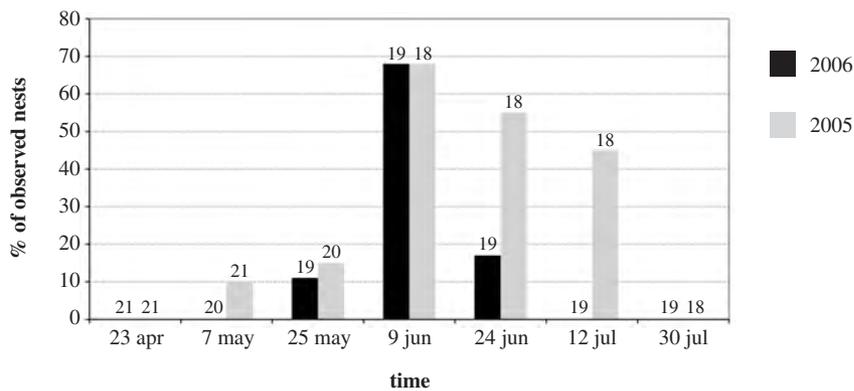


Figure 2. Percent of Cattle Egret nests with pulli; above each column is given the number of sample nests.

were 53% of nests below 4 m (from water level), in 2005 and 2006 less than 35%. Paired comparisons with Mann-Whitney U test showed a significant difference ($P < 0.05$) between 2004 and 2006 values for nest height and nests per occupied tree.

Until the end of March we did not observe any Cattle Egret nest; the first nests were found in the first decade of April (for 2005 and 2006). Therefore the start of nest building begun the first week of April. Fig. 1 and Fig. 2 summarize the breeding chronology of Cattle Egret recorded in 2005 and 2006; from these data we can estimate the onset of laying between 10 and 15 April, while a major peak of incubating activity was mainly recorded between 7 and 25 May. Hatching started between 7 and 25 May, peaking in the beginning of June (at 9 June 68% of the sample broods were already hatched). At the end of July all newborn Cattle Egrets were fledged. At the end of August the colony was abandoned also by the last fledged birds. Fig. 2 shows that the breeding activity lasted about 15 days more in 2005 than in 2006.

The breeding parameters found in this study are summarised in Tab. 3, in comparison with data reported in literature. The mean numbers of hatched Cattle Egrets were not statistically different in 2005 and 2006, the values were respectively 2.2 (S.D. = 0.67; $N = 18$) and 2.7 (S.D. = 1.1; $N = 16$); the pooled data give an average of 2.5 (S.D. = 0.95).

As we observed the sample nests from outside the colony by means of spotting scopes, we were not able to see and count the eggs in all the sample nests. Therefore we could not calculate the average clutch size; however we were able to see one sample nest with only 1 egg hatched and another nest with 5 chicks plus 1 egg not hatched. Since the number of chicks per nest was never higher than 5, we could reasonably estimate that the clutch size ranged from 1 to 6 eggs. The median date of nest-with-eggs and nest-with-pulli distributions were respectively 17.5 May - 11 June and 16 May - 8 June in 2005 and 2006. The difference yields respectively to a length for the incubation period of 24.5 and 23 days; the average of these two values

Table 1. Number of herons found in Perotto Lake heronry. No. of Birds = total number of birds (nesting and non nesting) censused in the heronry at the end of July.

Species	2004	2005	2006
	no. of birds	no. of birds	no. of birds
Night Heron	2	1	2
Little Egret	12	15	27
Squacco Heron	2	2	7
Cattle Egret	371	478	814
Grey Heron	3	3	10

Table 2. Nest crowding and nest heights. Nests per tree are average values. Nest heights are average values from ground level.

	2004	2005	2006
Trees with nests	54	54	86
Total of nests	111	132	253
Nests per tree	2.06	2.44	2.94
s.d.	1.69	2.91	2.85
Range	1 – 9	1 – 19	1 – 20
Nest height (m)	6.69	7.06	7.27
s.d.	2.51	1.89	2.06
Range	3.5 – 12	2.5 – 10	3 – 14

is 23.8 days, very close to all other average data available in literature ranging from 22 to 24 days (Blaker 1969, Weber 1975, Maxwell and Kale 1977, Hilaluddin *et al.* 2003, German Cupul-Magaña 2004).

Due to the finding of very late nests in late June and July 2005, we suggest that the number of broods for Cattle Egrets in Perotto heronry should be 1 or 2. Moreover walking in the dried wood under the heronry (during the nest counts) we found a nest built up less than 0.5 m from ground level in a site which was surely submerged by water until the first week of June; as a consequence that particular nest was surely built after 8 June. Adult Cattle Egrets carrying nest material in the bill were observed also in the first decade of June (2005). These facts support the hypothesis that some Cattle Egrets pairs have a second brood during the same breeding season.

During all the observation periods we did not see any predatory activity on the sample nests; we did not find any dead chick in the nests nor under the colony. We did not find any remains of dead chicks walking under the colony at the end of the breeding season. Two nests fell off - probably for stormy weather - causing a loss of only 10% of chicks over the sample nests. These findings resulted in relatively high survivorship rate (average 2.2 fledged

young/brood), which however is very similar to those reported by McKilligan (1985) for Australia, Parejo *et al.* (2001) for Spain, Hilaluddin *et al.* (2003) for India, German Cupul-Magaña (2004) for Mexico.

DISCUSSION

Our results confirm the expansion of Cattle Egret population recently found by other authors for Italy (Grussu *et al.* 2000) and for Grosseto province (Giovacchini *et al.* 2001). Interestingly, this remarkable increase of the Cattle Egret presence was accompanied by a settlement and increase of other Ardeidae (e.g. the first breeding case of Squacco Heron in Grosseto province). We hypothesize that gathering of many Cattle Egrets for roost during winter and the presence of many nesting pairs during spring might have attracted other heron species in the Perotto Lake wood.

Data from recent censuses (Centro Ornitologico Toscano 2005, unpublished report) show that Perotto Lake heronry got the highest increase of nesting Cattle Egrets for Grosseto province. We suggest that the following positive factors might have played an important role: a) the suitability of the flooded willow wood as a nesting habitat; b) the presence of an area with rice fields near the colony; as suggested by Prosper and Hafner (1996), this is a valuable feeding habitat for Cattle Egrets; c) the presence of many grazing sheep flocks, cattle and horses around the nesting site.

Although the number of nesting pairs showed a 126% increase during the last three years, the active nesting area did not increase and the number of trees with nests increased only by 56% in the same period. This led to an increased crowding of the colony (from 2.06 to 2.94 nests per occupied tree). Ranglack *et al.* (1991) found a positive correlation between nest density and hatching success, while Parejo *et al.* (2001) failed to detect a density-dependent effect on breeding parameters. Therefore the interpretation of this phenomenon is controversial and unclear, although it might be related to an anti-predatory strategy of these colonial birds.

The increased crowding observed in the colony was accompanied by a slight shift to the highest tree sites, particularly evident if 2004 and 2006 data are compared. This result suggests a preference for the relatively lower tree sites (which were occupied first in 2004) in contrast with the findings reported by Si Bachir *et al.* (2000), who found a preference for the highest nest sites. However it must be considered that the colony studied by Si Bachir *et al.* (2000) was located on *Fraxinus angustifolia*, while the Perotto Lake colony was settled on *Salix alba*; the dif-

Table 3. Breeding parameters of the Cattle Egret presented in literature. Data are mean values (in brackets: min - max values).

Location	Colony size (pairs)	Clutch size	Nestlings/ brood	Fledged young/brood	References
Italy	-	3.9	-	2.7	Brichetti and Grussu 1992
Italy	253	(1 – 6)	2.5	2.2	This study
Spain	760 -1000	-	2.1	1.9	Parejo <i>et al.</i> 2001
Spain	557	-	1.9	1.7	Parejo <i>et al.</i> 2001
France	107	4.8	3.9	3.1	Hafner 1978
Spain	1600	3.6 (2 – 6)	2.8	-	Prosper and Hafner 1996
Algeria	511	2.8 (1 – 5)	1.9	1.7	Si Bachir <i>et al.</i> 2000
Morocco	153	3.2	2.4	1.8	Franchimont 1985
Morocco	107	3.4	2.3	0.8	Franchimont 1985
Australia	711	3.6	2.8	2.1	McKilligan 1985
Brazil	1222	2.5	1.9	1.1	Petry and Fonseca 2005
India	550	3 (1 – 6)	2.5	1.9	Hilaluddin <i>et al.</i> 2003
South Africa	155	2.9	1.9	1.5	Blaker 1969
USA	697	3.6	3	2.8	Telfair 1983
USA	2650	3 (2 – 5)	2.1	-	Maxwell and Kale 1977
South Africa	1416	2.9	1.7	1.1	Siegfried 1972
USA	-	2.9 (1 – 7)	1.9	1.1	Ranglack <i>et al.</i> 1991
Mexico	169	2.8	2.4	2.2	German Cupul-Magaña 2004
USA	46	2.5	2.1	1.7	Dindo and Marion 1987
USA	383	3	2.8	1.4	Wiese 1976
USA	150	2.9 (2 – 5)	2.5	1.8	Weber 1975
USA	4500	2.4	0.7	0.4	Dusi and Dusi 1969

ferent morphology of these tree species might explain the different Cattle Egret choice, suggesting a general preference for denser stands. The phenology of the reproduction seems coherent with the information known for the Palearctic region: i.e. Si Bachir *et al.* (2000) found the beginning of nest building at the end of March in a colony settled in Kabylie (Algeria), while we estimated the start of nest building in the first week of April. A major peak in incubating activity in May, followed by a consistent activity again in June (possibly related to second broods) was already reported by Hafner (1980) in Camargue (France) and by Prosper and Hafner (1996) in Albufera (Spain).

We have found strong evidences that Cattle Egrets lay a second clutch in Perotto Lake heronry, but we do not have data to suggest if these were replacement clutches or true second broods. However a second (and even a third) brood is reported in several instances (Maxwell and Kale, 1997; Prosper and Hafner, 1996, Si Bachir *et al.*, 2000; see also in literature Cramp 1980).

The range in the clutch size we could estimate from our observations (1-6) is quite coincident with existing knowledge (see Tab. 3). Unfortunately, we could not estimate the average clutch size on our sample of nests. On the

other hand, the average reproductive success of 2.2 fledglings/brood, found in Perotto Lake colony, was a relatively high value, as 14 out of the 19 studies included in table 3 report for less than 2.0 fledglings/brood.

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