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Time of Breeding and Brood Size of White Storks (*Ciconia ciconia*) in North-eastern Greece

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Abstract: Goutner, V. & E. P. Tsahalidis (1995): Time of Breeding and Brood Size of White Storks (*Ciconia ciconia*) in North-eastern Greece. Vogelwarte 38: 89–95.

The time breeding and the brood size of White Storks (*Ciconia ciconia*) were studied in five localities (a total of 14 village areas) of North-eastern Greece in 1993. The age of nestlings was estimated from bill measurements using a regression available from a previous study on White Storks reared in captivity. Egg laying extended from the beginning of March to the end of April showing a peak from the second ten day period of March to the beginning of April. The pattern of egg laying differed significantly between the areas studied; and the mean laying dates also differed significantly even within areas in some of the localities. Brood size (mean 3.01±0.95 SD) varied between localities and it was inversely correlated to the time of egg laying initiation of each nest.

Key words: *Ciconia ciconia, breeding,* brood size, Greece.

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1. Introduction

The White Stork (*Ciconia ciconia*) is a species declining in numbers and hence needing conservation throughout its region (GORIUP & SCHULZ 1990). Greece hosts a part of the eastern breeding population which, seems to be declining although the census data are slight (HÖLZINGER & KÜNKELE 1986, BOETTCHER-STREIM & SCHÜZ 1989, JERRENTRUP 1989). Although in terms of breeding population size Greece is one of the most important breeding areas of White Storks in Europe (third after Spain and Portugal), limited studies have been carried out till now, mainly relevant to numbers, distribution and partly on breeding success (MARTENS 1966, WARNCKE 1967, HECKENROTH 1969, HÖLZINGER & KÜNKELE 1986, JERRENTRUP 1989). In this study, we provide data of the breeding biology of White Storks in Greece, making a more detailed analysis on the time of breeding based on measurements of nestlings and brood size.

2. Study area and methods

A number of areas in North-eastern Greece (Central Macedonia, Western Thrace) were selected for this study (Fig. 1). This geographical area hosts the most important breeding populatiions of White Storks in Greece (HÖLZINGER & KÜNKELE 1986). We selected five localities along the east-west axis of North-East Greece and sampled some different areas in each locality (Table 1). We visited a total of 75 nests between 8 and 28 June 1993. Because almost all the nests were made on electric power poles, access to each nest was possible only by the use of a „cherry picker" operated by technicians of the Public Power Corporation, after power was interrupted for varying periods of time. This work was limited to some areas by either inaccessibility of nests or technical problems related to electric power provision.

To estimate the dates of egg laying, the age of chicks was calculated using bill length. We measured th upper mandible of the bill (tip to feathers) of all nestlings to the nearest mm using slide callipers. The age of each nestling was estimated by the regression equation:

$$\text{BILL} = 1.58 \text{ X AGE} + 13.956 \qquad (R^2 = 0.976)$$

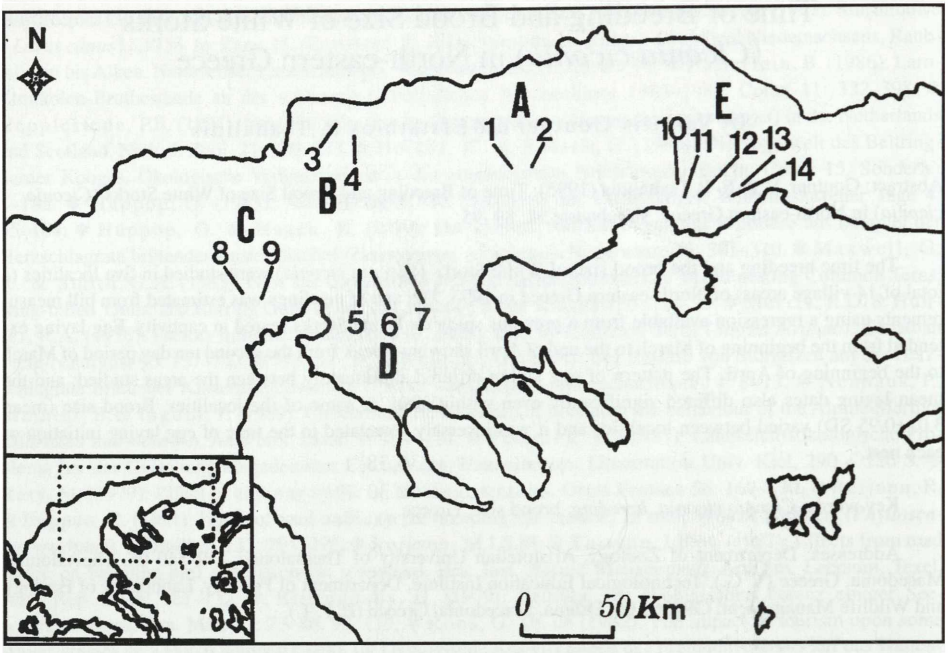

Fig. 1: Map of Greece indicating the areas studied. Numbers represent the localities studied in each area (for the names see Table 1).

This equation was produced by measuring White Storks reared in captivity in Macedonia (POULOPOULOS & GOUTNER, unpubl.). Data on the growth of White Storks in natural conditions are still lacking from Greece, and growth curves from other areas should not be used (see discussion). The advantage of using bill measurements is based on the fact that – in contrast to other body measurements – White Stork bill growth curves practically do not level-off even after 70 days of life (KANIA 1988, GANGLOFF et al. 1989), an age around which nestlings are able to fly (HANCOCK et al. 1992). Because in White Storks hatching is asynchronous, growth of nestlings in a nest may well be different. On the other hand, these birds lay eggs at intervals of 1–4 days (CRAMP & SIMMONS 1977). Thus we considered that when in broods of two, three, four and five nestlings the age difference between the youngest and the eldest were no more than three, six, nine and 12 days respectively, these differences could be due to normal egg laying intervals and not to different development. Nestlings beyond these intervals were not taken into account in the analyses (of 222 nestlings data from 189 were used). We took the incubation period of White Storks as 30 days (CHOZAS 1986), instead of the 33–35 days stated for northern European populations (CRAMP & SIMMONS 1977), because there is greater similarity in time of breeding between the Greek and the Spanish populations than between either and that of north-west Europe, both in White Storks (CHOZAS 1986, this study) and also in other waterbirds (GOUTNER 1986). Statistical tests were performed on log-transformed data for normality where necessary.

This study was made possible thanks to the collaboration of the Public Power Corporation which providet us with equipment and technicians. The Department of Forestry of the Technological Education Institute (Drama, Greece) partly subsidized the project. W. Kania (Ornithological Station, Gdansk) made useful comments and suggestions on an earlier draft and Alan Waugh (British Council, Thessaloniki) corrected the English language of the manuscript.

Table 1: Localities, date of nest visitation and number of storks measured in this study. Symbols of localities and areas refer to those in Fig. 1.

Name of locality	Locality code	Area	Coordinates	Date (6/93)	Nr of storks measured
Megalokampos	A1	1	41°06'30"N 24°01'30"E	8	18
Nikotsara	A2	2	41°06'40"N 24°03'10"E	8	6
Kerkini	B1	3	41°12'30"N 23°05'10"E	10	28
Limnochori	B2	4	41°12'30"N 23°12'00"E	11	23
Anatoliko	C1	5	40°39'35"N 22°43'30"E	22	6
Kymina	C2	6	40°36'38"N 22°42'30"E	22	19
Nymphopetra	D1	7	40°41'00"N 23°20'08"E	28	9
Aghios Vassilios	D2	8	40°39'25"N 23°07'00"E	16	11
Kavalari	D3	9	40°42'30"N 23°03'30"E	16	16
Pondolivado	E1	10	40°58'39"N 24°31'30"E	17	9
Eratino	E2	11	40°57'06"N 24°38'00"E	17	17
Ziloti	E3	12	40°59'00"N 24°49'30"E	18	8
Dekarcho	E4	13	40°55'20"N 24°50'00"E	18	7
Maggana	E5	14	40°56'30"N 24°51'50"E	18	12

3. Results

Time of laying

The time of laying range of White Storks in the study extended from the beginning of March to the end of April (Fig. 2). The earliest egg of the study year was laid on 1 March in the area of Aghios Vassilios (Lake Koronia) and the latest on 30 April at Maggana near the Nestos Delta. In one nest of the village Kerkini we found eggs incubated on 10 June, which means that some eggs were probably laid in May. The laying peak occurred between the second ten-day period of March and the beginning of April. In this period 90% of the total number of eggs were laid. A significant difference was found in the pattern of egg laying among the localities studied ($\chi^2 = 39.08$, $p = 0.001$, Fig. 2). The mean egg laying date varied considerably even within areas in some of the localities studied (Fig. 3): at locality D, situated in the region of the Lakes Koronia and Volvi, the storks started laying on significantly different dates (ANOVA, $F = 6.81$, $p = 0.003$), the differences being between the village of Aghios Vassilios – where earliest laying occurred – and both other areas Nymphopetra (20.2 km distant) and Kavalari (9.5 km distant) (Fisher Least Significance Distance (L. S. D) test)

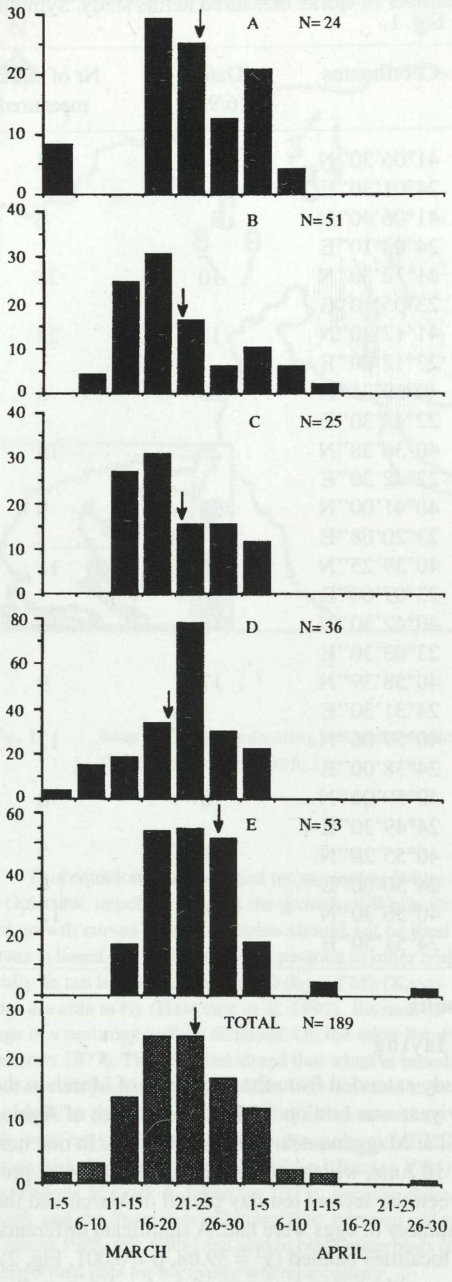

Fig. 2: Time of laying of White Storks in the study localities (A–E). The arrow indicates the mean laying date in each locality. For the names of the localities see Table. 1.

Within locality E, the earliest laying occurred in the area of the village Dekarcho and the latest at the village of Maggana. The difference in the mean laying date among the areas in this locality was significant ($F = 3.25$, $p = 0.019$), due to significant differences between the villages Eratino and Dekarcho (16.5 km, distant), Ziloti and Dekarcho (12 km), and Dekarcho and Maggana (6.2 km) (Fisher L. S. D test).

Brood size

Nests contained one to five nestlings. Four broods (5.3%) were of one nestling, 15 (20.0%) of two, 38 (50.7%) of three, 12 (16.0%) of four and six (8%) of five nestlings. Mean brood size varied between localities ($F = 2.64$ $P = 0.041$, Table 2) the main difference being between localities A and D (Fisher L. S. D test). We also detected differences between areas within localities but sample sizes are small for further comparisons.

Brood size was inversely correlated to the time of egg laying initiation in each nest ($F = 9.21$, $p = 0.0001$, Fig. 4). The main differences were between brood size of 1, 2, 3 and that of 5 nestlings and between that of 2 and 3 (Fisher L. S. D test).

4. Discussion

In this study the laying-time of White Storks was estimated by the growth of birds raised in captivity. KANIA (1988) used data of White Storks raised in captivity, originating from the north-western European population, to construct a conversion table for estimating the time of hatching from bill measurements. Comparison of these data with ours (POULOPOULOS & GOUTNER, unpubl., see regression equation above) suggested that the growth of White Storks from north-west Europe is more rapid than that in Greece. Although more data are needed to verify this, growth curves from the north-western population do not seem to be applicable to our study area. Consequently we suggest that such growth curves should be produced from and used for local populations.

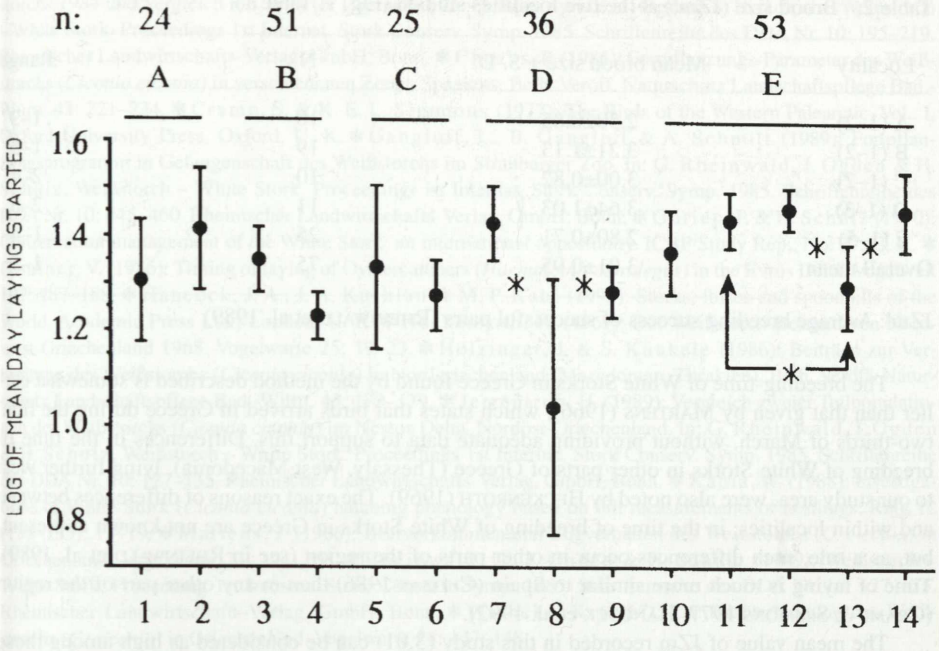

Fig. 3: Mean date of laying the first eggs in each area of the study localities (A–E) with 95% confidence intervals (1 March = 1). An asterisk indicates a significant difference between areas. n: number of measured storks.

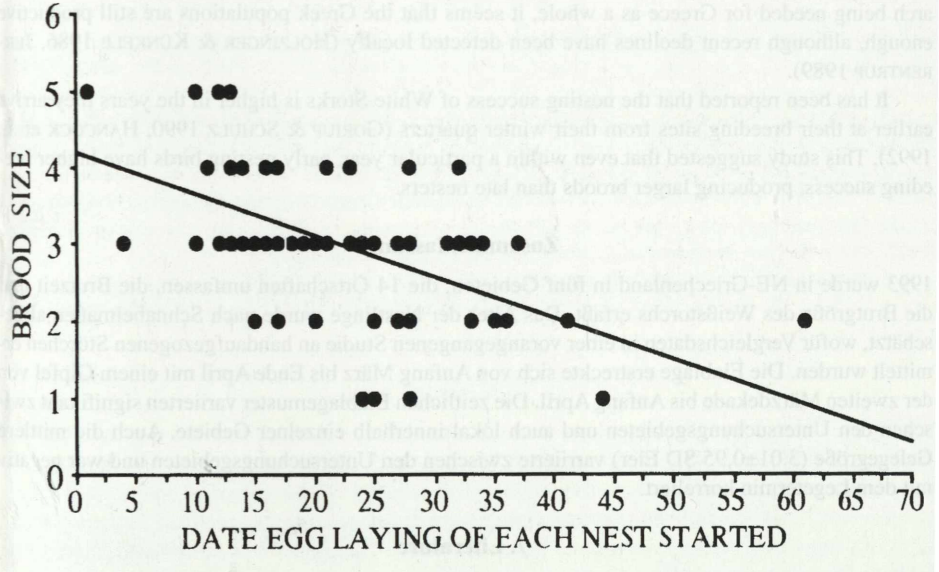

Fig. 4: Relationship between time of laying at each nest (N = 75) and brood size in the stage of fledging of White Storks in North-eastern Greece (1 March = 1) ($y = -0.054x+4.185$, $R^2 = 0.295$, df = 73).

Table 2: Brood size (JZm*) at the five localities studied (Fig. 1, Table 1).

Locality	Mean brood size ± S. D.	N	Range
A (1–2)	2.50±0.85	10	1–3
B (1–2)	3.21±1.13	19	1–5
C (1–2)	3.00±0.82	10	2–4
D (1–3)	3.64±1.03	11	2–5
E (1–5)	2.80±0.71	25	1–4
Overall mean	3.01±0.95	75	1–5

JZm*: Average breeding success of successful pairs (RHEINWALD et al. 1989)

The breeding-time of White Storks in Greece found by the method described is somewhat earlier than that given by MARTENS (1966), which states that birds arrived in Greece during the final two-thirds of March, without providing adequate data to support this. Differences in the time of breeding of White Storks in other parts of Greece (Thessaly, West Macedonia), lying further west to our study area, were also noted by HECKENROTH (1969). The exact reasons of differences between and within localities, in the time of breeding of White Storks in Greece are not known at present, but, as a rule, such differences occur in other parts of the region (see in RHEINWALD et al. 1989). Time of laying is much more similar to Spain (CHOZAS 1986) than in any other part of the region (CRAMP & SIMMONS 1977, HANCOCK et al. 1992).

The mean value of JZm recorded in this study (3.01) can be considered as high among those recorded in Europe. It is generally higher than the respective mean value of north-west European countries (BAIRLEIN 1991, HANCOCK et al. 1992) and also of Spain, Portugal and countries neighbouring Greece (see RHEINWALD et al. 1989). In the sixties Martens (1966) recorded even higher JZm values fo Thessaly and Western Macedonia (3.11 and 3.18 respectively). Despite more research being needed for Greece as a whole, it seems that the Greek populations are still productive enough, although recent declines have been detected locally (HÖLZINGER & KÜNKELE 1986, JERRENTRUP 1989).

It has been reported that the nesting success of White Storks is higher in the years they arrive earlier at their breeding sites from their winter quarters (GORIUP & SCHULZ 1990, HANCOCK et al. 1992). This study suggested that even within a particular year, early nesting birds have higher breeding success, producing larger broods than late nesters.

Zusammenfassung

1993 wurde in NE-Griechenland in fünf Gebieten, die 14 Ortschaften umfassen, die Brutzeit und die Brutgröße des Weißstorchs erfaßt. Das Alter der Nestlinge wurde nach Schnabelmaßen abgeschätzt, wofür Vergleichsdaten in einer vorangegangenen Studie an handaufgezogenen Störchen ermittelt wurden. Die Eiablage erstreckte sich von Anfang März bis Ende April mit einem Gipfel von der zweiten Märzdekade bis Anfang April. Die zeitlichen Eiablagemuster variierten signifikant zwischen den Untersuchungsgebieten und auch lokal innerhalb einzelner Gebiete. Auch die mittlere Gelegegröße (3.01±0,95 SD Eier) varriierte zwischen den Untersuchungsgebieten und war negativ mit dem Legetermin korreliert.

7. Literature

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