

Nesting habits and breeding success of the White Stork, *Ciconia ciconia*, in the Kızılırmak delta, Turkey

(Aves: Ciconiidae)

Kiraz Erciyas Yavuz, Nizamettin Yavuz, José Tavares, Y. Sancar Barış

Abstract. A total of 926 nests of the White Stork (*Ciconia ciconia*) was found in a survey conducted in the Kızılırmak delta on the Black Sea coast of Turkey in 2010. Breeding success was 3.82 young per successful nest, which is very high compared to other studies in and outside Turkey. The breeding population has increased from 125-130 pairs in 1992 to at least 870 breeding pairs in 2010 (158.5/100 km²). This population increase is apparently related to the increase in rice cultivation, which has more than tripled in the delta since 1992.

Key words. White Stork, nesting substrates, breeding success, monitoring, Kızılırmak delta, Turkey, population numbers.

Introduction

The White Stork (*Ciconia ciconia* (Linnaeus, 1758)) is a widespread and relatively abundant migrant breeder in Turkey up to at least 2,200 m a.s.l., but population density is low in south-eastern Anatolia and it breeds only very locally in the Black Sea coastlands (KASPAREK & KILIÇ 1989, KIRWAN et al. 2008).

White Storks are well studied in most European countries. Following several international censuses, the world population was estimated at 230,000 breeding pairs in 2004/2005, which means a 39% increase since the 1994/1995 International White Stork Census. Population numbers have decreased in only four countries: Uzbekistan, Denmark, Bosnia Herzegovina and Turkey. KASPAREK & KILIÇ (1989) recorded a significant decline in the mean number of nests per village in Turkey between 1965 and 1985. In 2004/05 6195 breeding pairs were counted in Turkey (NABU 2006), although this number may not reflect the total population. BURFIELD & VAN BOMMEL (2004) estimated the Turkish population to be 15,000-35,000 pairs in 2001, though it may have declined by more than 50% between 1970 and 1990 (PARR et al. 1996). The role of prey availability and access to suitable feeding habitats in the vicinity of human settlements during the breeding season is rather well understood in White Storks. The species is therefore a good indicator for testing the influence of major habitat disturbances in arable lands, such as agricultural intensification (JOHST et al. 2001, TRYJANOWSKI et al. 2009). Moreover, the White Stork is a good biodiversity indicator (TOBOLKA et al 2012), and so the monitoring of local population changes is important.

In the Kızılırmak delta in northern Turkey, the only previous study on White Storks dates back to 1992, when HUSTINGS & DIJK (1994) counted 125-130 breeding pairs in the area. Although, more recently, White Storks appear to have increased substantially in the delta, so far no further population surveys have been made. This study aims to estimate current population numbers and the breeding success of the species in the Kızılırmak delta.

Study area and methods

The study was conducted during the breeding season 2010. Kızılırmak delta is the largest and most intact wetland on Turkey's Black Sea coast. It is located between the cities of Sinop and Samsun at latitudes 41°30'-41°45'N and 35°43'-36°08'E and lies 0-15 m a.s.l. It has a surface area of approximately 560 km²; 217 km² of these were declared a Ramsar site in 1998. 70% of the delta is cultivated, while the rest is covered by natural habitats, mainly by open water (91 km²), freshwater and semi-saline lakes, marshlands, sand-dunes and woodlands (DIKSEN & KASPAREK 1985, HUSTINGS & DIJK 1994). Farmland areas are mainly cultivated with rice.

The survey area is situated north of the Sinop - Samsun highway. A preparatory survey of old nests and possible nesting sites was conducted in February 2009, at a time when all the deciduous trees covering most of the eastern part of the study area were lacking foliage. In 2010 all already-known nests were controlled and the nest surveys were extended to the rest of the eastern and to the western parts of the study area. While all nests were located on 1 x 1 km grid maps, for investigating nest occupancy and nesting success nests were visited several times between early March and the end of July. In addition, nesting substrates and nest height and width were estimated. Breeding success was established according to the numbers of young present in the nests in June and July.

The large, obvious nests of White Storks are often associated with human settlements. It is very unlikely that any nests in these habitats were overlooked during the study. However, as very dense and flooded forests could not be visited, our figures certainly underestimate the breeding numbers in these habitats.

There are some patches of natural woodland in the study area where the White Storks built nests in groups, which are defined as "breeding colonies". The maximum distance between the nests was approximately 50 metres, and the colonies share the same habitat. When some nests were close but were separated by a different type of habitat, they were excluded from the colony and were considered as single nests. The total area covered by the colonies was taken as the total area of the woodland patches.

Results

Nests were found throughout the delta, but in some areas in higher concentrations than in others. In some areas White Storks bred in small woodlands in loose colonies, with a maximum of 62 breeding pairs in one location, and 12 nests in a single tree. There were 19 colonies with the same character. Table 1 gives the number of nests and the area covered for each colony. Beside the nests, a lot of feeding birds were seen in many places, in particular in rice fields and at several sites in marshlands.

A total of 926 nests was found in Kızılırmak delta. 336 nests were situated on the west side of the river, while 590 nests were placed on the east side. The distribution of the nests is shown in Fig. 1. 21 nests were not found again because of the dense vegetation in summer, i.e. nest occupancy could be established for 905 nests (97.7%).

A total of 870 nests, i.e. 96.1% of all nests in the area, were occupied. In June and July 2010, 602 nests were revisited to establish nesting success. Because 313 nests could only be partially observed or could not be found again because of the dense vegetation, the number of young was confirmed for only 289 nests. In these a total of 1104 young, close to fledgling age, with a range of 1-6 young, was counted which gives a mean of 3.82 young per successful nest (Table 2).

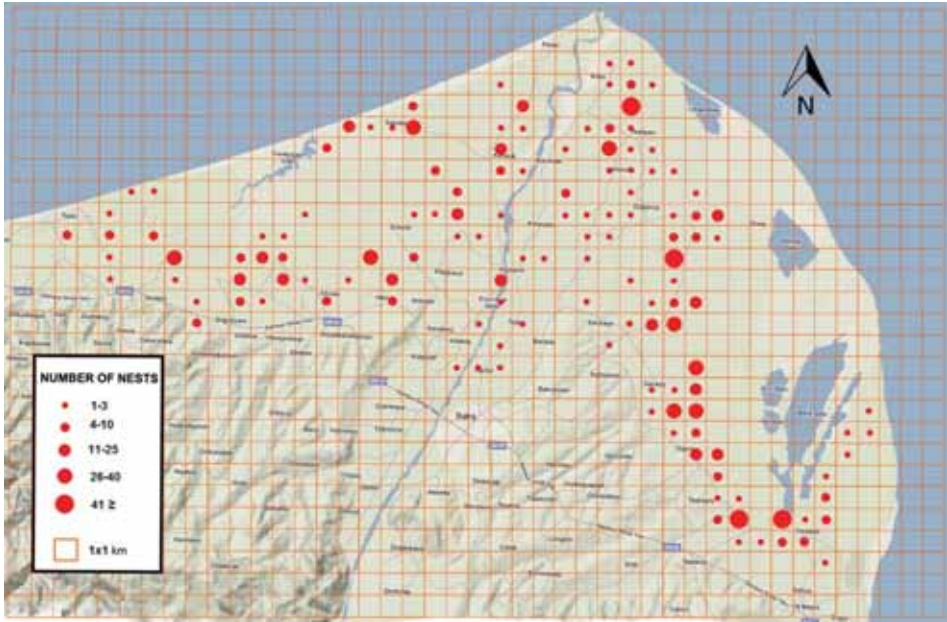


Fig. 1. Distribution of White Stork (*Ciconia ciconia*) nests in Kızılırmak delta, Turkey, 2010.

Table 1. Number of nests in the White Stork (*Ciconia ciconia*) colonies and the total area covered. A polygon on Google Earth Pro was drawn over the area where the colonies occur. The edge of the polygon was the edge of the small woodland patches. Google Earth gives/measures the total area covered by the polygon.

Colony number	Number of nests	Area (m ²)
1	40	45,800
2	36	84,500
3	38	94,200
4	15	11,000
5	46	138,000
6	28	83,500
7	46	78,800
8	13	53,000
9	62	150,300
10	18	6,800
11	43	65,600
12	12	11,700
13	10	17,500
14	45	64,000
15	19	37,500
16	19	6,000
17	13	8,500
18	11	6,000
19	16	9,500

Table 2. Number of White Stork (*Ciconia ciconia*) nests, number of juveniles and mean number of fledglings per nest in Kızılırmak delta, Turkey, 2010. Abbreviations used for the International White Stork Census (e.g. SCHÜZ 1952): HPa = number of breeding pairs, HPm = number of breeding pairs with young, HPo = number of breeding pairs without young, JZG = total number of juveniles, JZm = mean number of juveniles per successful nest.

Total number of nests	926
Number of occupied nests (Hpa)	870
Number of nests with young (only nests with exact number of young is given) (HPm)	289
Number of nests with young (HPo)	0
Total number of fledged young (JZG)	1104
Mean number of fledglings per successful nest (JZm)	3.82 ± 0.72

The majority of nests ($n = 900$) were placed in trees: 849 in ashes (*Fraxinus* sp.), 24 in poplars (*Populus* sp.), 19 in oaks (*Quercus* sp.), 4 in planes (*Platanus* sp.), 3 in pine trees (*Pinus* sp.), and 1 in a willow (*Salix* sp.). Only 26 nests were found on anthropogenic substrates: 5 on telephone pylons, 19 on the roof of buildings, and 1 each on an electricity pole and on a platform. Compared with the results of GÖCEK et al (2010) and KILIÇ (2010), Kızılırmak delta is the only area in Turkey where White Storks built their nests in trees (Table 3). In 57 trees there were 2 nests, in 24 trees were 3 nests, in 3 trees were 4 nests, in 1 tree were 5 nests, in 3 trees were 6 nests, in 2 trees were 7 nests and in 1 tree were 8 and 9 nests. 28% of all nests in trees were occupied by at least two or more pairs. A tree which harboured 12 nests was recorded in Habilli in 2009. This tree collapsed during heavy winds in February 2010, but the storks built new nests on neighbouring roofs and trees.

The estimated diameter of the nests varied between 0.5 and 2 m. Most of the nests had a width of 1-1.5 m (517 nests). The height varied from 4 to 17 m. Most of the nests were positioned at a height of 9-10 m (146 nests). There was no significant difference between the breeding success and the width and height of the nests.

Discussion

The present study indicates that the Kızılırmak delta currently harbours large numbers of breeding White Storks. The Kızılırmak delta harbours 1.59 breeding pairs/km², but when we exclude the 91 km² of open water from the total area this will be 1.85 breeding pairs/km². GRISHCHENKO & YABLONOVSKA-GRISHCHENKO (2010) reported 1.56 breeding pairs/km² (total area 780 km²) from Ukraine, VERGARA et al. (2007) 0.16 pairs/km² (total area 7740 km²) from Spain, TRYJANOWSKI & SPARKS (2008) 0.08 pairs/km² (total area 1227 km²) from western Poland, and PROFUS et al. (2004) 0.01 pairs/km² (total area 6915 km²) from southern Poland. GÖCEK et al. (2010) reported 0.01 breeding pairs/km² (total area 1580 km²) from central Turkey and 0.18 pairs/km² (total area 204 km²) from western Turkey. Compared to nesting densities in and outside Turkey, the density is high in the Kızılırmak delta.

Table 3. Distribution of the substrate of White Stork nests in different study areas in Turkey. Ankara (Kızılcahamam): GÖCEK et al. (2010), İzmir (Gediz delta): GÖCEK et al. (2010), Diyarbakır (Bismil): KILIÇ (2010) and Kızılırmak delta: this study.

	Kızılırmak delta	Kızılcahamam	Gediz delta	Bismil
Trees	97.2	0	0	0
Chimney	0	30.4	1.4	0
Roof	2	21.7	5.4	0
Electricity pole	0.1	36.2	91.9	100
Telephone pole	0.7	11.6	1.4	0

In general, White Storks prefer open natural or extensively cultivated lowlands, wet grasslands and farmlands where shallow waters, flooded lands, rice fields and arable fields offer extensive, easily accessible food supplies (CRAMP 1998, SNOW & PERRINS 1998). The breeding productivity of the White Stork is greatly affected by prey and foraging habitat types (THOMSEN & STRUWE 1994), and the Kızılırmak delta provides different types of habitats for abundant foraging by the White Stork. The rice fields, water edges, wet meadows provide sufficient food supplies, e.g. earthworms, reptiles, amphibians, insects, both for adults and for juveniles. Both the high breeding numbers and the high reproduction indicate that suitable habitats may be abundant in the delta.

In comparison to the study by HUSTINGS & DIJK (1994), population numbers of White Storks have increased from 125-130 breeding pairs in 1992 to 870 breeding pairs in 2010. KIRWAN et al (2008) noted that 22 nests contained 55 young in the Kızılırmak delta on 26 July 1971, which gives a mean of 2.50 per nest. While these are the only published data on the breeding success of White Storks in the area, the mean number of fledglings per successful nest was calculated as 3.82 ± 0.72 in the present study. This is considerably higher than the long-term nesting success recorded in Western Poland (2.69, TOBOLKA et al. 2011), Spain (2.73 ± 0.04 , VERGARA & AGUIRRE 2006), Greece (3.72, GOUTHER & TSACHALIDIS 2007), Ukraine (2.96 ± 0.05 , GRISHCHENKO & YABLONOVSKA-GRISHCHENKO 2010), France (2.5 ± 0.1 , MASSEMIN-CHALLET et al. 2006) and elsewhere in Europe (GOUTNER & TSACHALIDIS 2007). Furthermore, it is also higher than the breeding success recorded in other studies in Turkey, in İzmir, Gediz delta (2.71 ± 1.21 , GÖCEK et al. 2010), Ankara, Kızılcahamam district (2.43 ± 1.7 , GÖCEK et al. 2010) and Diyarbakır, Bismil region (2.73, 2003-2007, KILIÇ 2010, KILIÇ & KARAKAŞ 2006). GÖCEK et al. (2010) reported a maximum JZm (average number of young per successful nest) of 4.20 ± 2.15 from Central Turkey, and a maximum JZm of 3.05 ± 1.23 from Western Turkey. KILIÇ (2010) reported a maximum JZm of 3.11 from Eastern Turkey. Thus, in comparison to European and other Turkish populations, the breeding success in the Kızılırmak delta was very high in 2010. But there was a higher breeding success in Kızılcahamam, Central Turkey, in 2004 (GÖCEK et al. 2010) which shows that yearly fluctuations in breeding success can occur and that the results for the Kızılırmak delta may be the consequence of a good year. A variety of factors such as weather conditions can affect breeding productivity of White Storks. During the breeding season in 2010, the precipitation was generally low (mean precipitation of 4.0, 3.2, 1.6 and 5.5 mm in March, April, May and June, respectively). Temperatures were moderate (monthly means of 7.4, 11.3, 17.2 and 21.4°C in March, April, May and June, respectively) (General Directorate of State



Fig. 2. White Stork, *Ciconia ciconia*.

Meteorological Works). Nestlings will thus avoid hypothermia during extensive rain and cold temperatures, which will increase the breeding success.

Habitat and food availability, in particular the food supply for adults feeding nestlings, and the breeding success of White Storks heavily depends on land use patterns and farming practices (STRUWE & THOMSEN 1991, JOHST et al. 2001, TRYJANOWSKI & KUZNIAK 2002). In the Kızılırmak delta cultivated farmlands cover a total area of 375.9 km² (67% of the study area) (YENIYURT et al. 2008) of which 112.1 km² were used for rice production in 2010 (Bafra Province Directorate of Agriculture). Whereas in the 1990s approximately 30 km² were cultivated with rice fields, the area of rice cultivation has more than tripled in recent years. Because, according to our observations, rice fields provide important feeding habitats for the species in the delta, the increase of rice farming may have had a positive effect on the breeding population. Furthermore, until the late 1990s, farmers used pesticides like Folidol to combat Mole Crickets (*Gryllotalpa gryllotalpa*) in rice fields. Changes in farming practices in 2000-2001 reduced the use of pesticides and nowadays no strong pesticides at all are used in rice fields in the delta. H. ORTA (pers. comm.) reported that he saw many dead White Storks near rice fields treated with pesticides before 2001, but during this study no dead birds were found in the delta. Only two farmers told us about some cases of power line collisions/electrocutions, but none were found during our investigation.

In the Kızılırmak delta, White Storks build nests mainly in trees. In comparison to other areas (GÖCEK et al 2010, KILIÇ 2010), Kızılırmak delta is the only area in Turkey where tree-

nesting predominates. TRYJANOWSKI et al. (2009) compared the number of chicks fledged on different nesting structures and found no differences. The sample size in structures other than trees is too low in our area to make a similar comparison. TRYJANOWSKI et al (2009) reported that the number of nests on electricity poles and chimneys increased while those on roofs and trees decreased during 1983-2006 in Poland. We need long term monitoring to assess this parameter. Ashes and oaks are characteristic in natural woodlands, while other tree species, like poplar, pine, planes and willows, are often planted in small plantations in the delta. Because 91% of all nests were built in ash trees, White Storks appear to prefer natural woodlands for nesting in the Kızılırmak delta. In other areas in Turkey (Gediz delta, Kızılcahamam, Bismil) trees suitable for nesting, are mainly available in plantations, but White Storks prefer to nest there on man-made structures like electricity poles, platforms and roofs. Although environmental factors affecting breeding success need further investigation, our results confirm the importance of prioritizing the conservation and management of natural woodlands as nesting habitats for the White Stork in the Kızılırmak delta.

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References

- BURFIELD, I. & F. VAN BOMMEL (2004): Birds in Europe: population estimates, trends and conservation status. – Cambridge (U.K.): BirdLife International Conservation Series 13.
- CRAMP, S. (1998): The Birds of the Western Palearctic. – Oxford & London (CD-ROM edition).
- DIJKSEN, L. & M. KASPAREK (1985): The birds of the Kızılırmak delta. – Birds of Turkey 4: 1-47.
- GÖÇEK, Ç., A. ÇİFTÇİ, M. SIKI & P. TRYJANOWSKI (2010): Breeding ecology of the White Stork *Ciconia ciconia* in two localities of Turkey. – Sandgrouse 32 (2): 156-162.
- GOUTNER, V. & E. P. TSACHALIDIS (2007): Brood size of the White Stork in Greece. – Waterbirds 30: 152-157.
- GRISHCHENKO, V. N. & E. D. YABLONOVSKA-GRISHCHENKO (2010): State of the White Stork population in Ukraine in 2010. – Berkut 19: 81-92.
- HUSTINGS, F. & K. VAN DIJK (1994): Bird census in the Kizilirmak delta, Turkey, in spring 1992. – WIWO Report 45.
- JOHST, K., R. BRANDL & R. PFEIFER (2001): Foraging in a patchy and dynamic landscape: human land use and the White Stork. – Ecological Applications 11: 60-69.
- KASPAREK, M. & A. KILIÇ (1989): Brutverbreitung und Bestandsentwicklung des Weißstorches (*Ciconia ciconia*) in der Türkei. In: G. RHEINWALD, J. OGDEN & H. SCHULZ (Eds), Weißstorch - White Stork. – Proceedings of the First International Stork Conservation Symposium. Schriftenreihe des Dachverbandes Deutscher Avifaunisten 10 (472 pp.).
- KILIÇ, A. (2010): The numerical changes of the stork population between the years 2005-2007. p. 46-55. In: K. HASPOLAT, K. GÜVEN & R. G. GÜVEN (Eds), Diyarbakır'da Doğal Hayat, Su, İklim, Enerji ve Maden. Volume III.
- KILIÇ, A. & R. KARAKAŞ (2006): Bismil (Diyarbakır)'de üreyen leylek (*Ciconia ciconia*) popülasyonunda 2003-2004 üreme döneminin karşılaştırılması [Comparison of the breeding population of White Stork (*Ciconia ciconia*) in Bismil (Diyarbakır) in 2003-2004 breeding seasons]. – VI. Ulusal ve Ekoloji Çevre Kongresi, Diyarbakır, p. 265-271.

- KIRWAN, G. M., K. A. BOYLA, P. CASTELL, B. DEMIRCI, M. ÖZEN, H. WELCH & T. MARLOW (2008): The Birds of Turkey: The distribution, taxonomy and breeding of Turkish Birds. – London.
- MASSEMIN-CHALLET, S., J. P. GENDNER, S. SAMTMANN, L. PICHEGRU, A. WULGUE & Y. L. MAHO (2006): The effect of migration strategy and food availability on White Stork *Ciconia ciconia* breeding success. – Ibis 148: 503-508.
- NABU (2006): Newsletter for the VI International White Stork Census 2004/2005. Vol. 3. NABU.
- PARR, S. J., P. COLLIN, S. SILK, J. WILBRAHAM, N. P. WILLIAMS & M. YARAR (1996): A baseline survey of White Storks *Ciconia ciconia* in central Turkey. – Sandgrouse 18: 46-51.
- PROFUS, P., P. TRYJANOWSKI, S. TWOREK & P. ZDUNIAK (2004): Intrapopulation variation of egg size in the White Stork (*Ciconia ciconia*) in southern Poland. – Polish Journal of Ecology 32: 75-78.
- SCHÜZ, E. (1952): Zur Methode der Storchforschung. – Beiträge zur Vogelkunde 2: 287-298.
- SNOW, D. W. & C. M. PERRINS (1998): The Birds of the Western Palearctic. Concise Edition. – New York.
- STRUWE, B. & K. M. THOMSEN (1991): Untersuchungen zur Nahrungsökologie des Weissstorches (*Ciconia ciconia* L. 1758) in Bergenhusen 1989. – Corax 14: 210-238.
- THOMSEN, K. M. & B. STRUWE (1994): Vergleichende nahrungsökologische Untersuchungen an Weissstorch-Brutpaaren (*Ciconia ciconia*) in Stapelholm und im Kreis Herzogtum Lauenburg. – Corax 15: 293-308.
- TOBOLKA, M., S. KUZNIAK, K. M. ZOLNIEROWIZ, L. JANKOWIAK, M. GABRYELCZYK, M. PYRC, P. SZYMANSKI & P. SIERACKI (2011): Increase of the White Stork *Ciconia ciconia* population in the Leszno District in 2010. – Chronmy Przyrodzie Ojczysta 67: 559-567.
- TOBOLKA, M., T. H. SPARKS & P. TRYJANOWSKI (2012): Does the White Stork *Ciconia ciconia* reflect farmland bird diversity? – Ornis Fennica 89 (early online).
- TRYJANOWSKI, P. & S. KUZNIAK (2002): Size and productivity of the White Stork *Ciconia ciconia* population in relation to Common Vole *Microtus arvalis* density. – Ardea, 90: 213-217.
- TRYJANOWSKI, P. & T. H. SPARKS (2008): The relationship between phenological traits and brood size of White Stork *Ciconia ciconia* in western Poland. – Acta Oecologica 33: 203-206.
- TRYJANOWSKI, P., T. H. SPARKS & P. PROFUS (2009): Severe flooding causes a crash in production of white stork (*Ciconia ciconia*) chicks across Central and Eastern Europe. – Basic and Applied Ecology 10: 387-392.
- VERGARA, P. & J. I. AGUIRRE (2006): Age and breeding success related to nest position in a White stork *Ciconia ciconia* colony. – Acta Oecologica 30: 414-418.
- VERGARA, P., J. I. AGUIRRE & M. FERNANDEZ-CRUZ (2007): Arrival date, age and breeding success in white stork *Ciconia ciconia*. – Journal of Avian Biology 38: 573-579.
- YENIYURT, C., S. ÇAĞIRANKAYA, Y. LISE & Y. CERAN (Eds) (2008): Kızılırmak Deltası Sulak Alan Yönetim Planı 2008-2012 [Wetland Management Plan of the Kızılırmak delta 2008-2012]. – Çevre ve Orman Bakanlığı, Ankara.

Authors' addresses: Dr Kiraz Erciyas Yavuz and Prof. Dr Y. Sancar Barış, Ondokuz Mayıs University, Ornithological Research Center, 55139 Kurupelit Samsun, Turkey. – Nizamettin Yavuz, Society for the Conservation of Nature and Wildlife, Atakum, Samsun, Turkey. – José Pedro Tavares, The Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, United Kingdom. – Email contact: kiraze@omu.edu.tr.