



# Foraging sites of breeding White Storks *Ciconia ciconia* in the South Wielkopolska region

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**ABSTRACT:** During the years 2002–2003 on the area of Baranów commune (Kępno district, South Wielkopolska) a research was conducted to indicate the foraging sites preferred by the White Storks during the breeding season. A great variability between the periods (6 periods, 20 days each) was shown. During periods 3 and 4 (28.05 do 6.07) birds foraged almost only on the meadows, while during the other periods they used equally often arable fields. Other foraging sites were used occasionally and especially during the two first periods (18.04 do 27.05), when the birds often moved between foraging sites. On the meadows birds were foraging in 82.4% of cases where there was no agricultural machines on the field, contrary to the fields where in 61.2% storks foraged during agricultural practices.

**KEY WORDS:** agricultural practice, foraging, habitat selection, human influence

## Introduction

The aims of this work were: to define birds' preferences in foraging in consecutive habitats during the whole breeding season, to indicate the crucial types of habitats used by these birds in the region, to demonstrate the correlation between type of foraging sites used by White Storks *Ciconia ciconia* and human agricultural practice.

Up to date in Poland a few researches have been done concerning exploitation of the particular types of foraging sites (in example Pinowska & Pinowski 1989, Pinowski et al. 1991, Tryjanowski et al. 2005). Whereas the foraging sites, as well as suitable places to build a nest, are a essential factor affecting the size of the breeding population (Jakubiec & Szymoński 2000). Changes occurring in agriculture, that often consist in shift from extensive to intensive agriculture, affects negatively on availability of feeding base of storks. The clutch size and breeding success depends directly from the richness of the food supplies (Tryjanowski &

Kuźniak 2002). Stork does not occur at all in the regions where forests or monocultures dominate.

## Research area

Research covered the whole Baranów commune (Kępno district, Wielkopolska voivodeship, SW Poland) of area 7431 ha, most of which is used as cropland (80%), then forests and urban areas (11.3 and 7.1% respectively). Area of the community is used by extensive agriculture, with small fields divided with numerous boundary strips. Agricultural areas compose a mosaic of crops and meadows, however, some parts of the region are covered with more concentrated green crops or cropland.

In 2002 in Baranów community 7 White Stork pairs bred ( $SD = 9.41$ ), while 1 additional nest was shortly occupied by 2 birds. One clutch was lost, and remaining 6 nests gave 16 fledglings. The next year, 6 nests were occupied by pairs ( $SD = 8.07$ ), and 1 nest was occupied by one bird. The nest success of one pair is not known, and remaining 5 nests gave 11 fledglings. For more details on the local White Stork breeding population see Rachel (2004).

## Methods

In 2002 the foraging sites of White Storks were controlled 19 times, while in 2003 36 times. There were 54 field in terrain all together, with 44 records of storks foraging. During the observation the presence of the bird on every type of foraging site was noted every 15 minutes (see below). More than once there were 2 or more storks. All in all 392 information about types of used foraging sites had been collected. Agricultural practice was conducted from April to August, that is to say in all months when storks are present in research area (own data) and Poland (Kania 1985).

In view of plants vegetation period and agricultural practice, the time of research was divided into 20-days periods, with the borders due to the qualitative changes of foraging sites. Their length were set because of changes in height of plants and first haymaking; the last 2 periods were during the harvest and ploughing time. There were 6 periods set, covering the following dates: 1<sup>st</sup> – 18.04 to 7.05 (low vegetation on the meadows as well as on the farmland or it's lack in the case of ploughed fields); 2<sup>nd</sup> – 8. to 27.05 (beginning of the haymaking); 3<sup>rd</sup> – 28.05 to 16.06; 4<sup>th</sup> – 17.06 to 6.07 (end of haymaking, hay had been taken from most of the meadows); 5<sup>th</sup> – 7. to 26.07; 6<sup>th</sup> – 27.07 to 15.08 (harvest and ploughing time).

Most of the commune's area was controlled. During the first visit a fragment of the area with representative habitats was toured – to control possibly many potential foraging sites of storks. Foraging sites were divided into 9 general categories. There were:

- farmland: ploughed, stubble field, with young vegetation up to about 20 cm height and with high vegetation;
- meadows and pastures: with low grass up to 20 cm, with grass higher than 20 cm and just after the haymaking with parted hay;

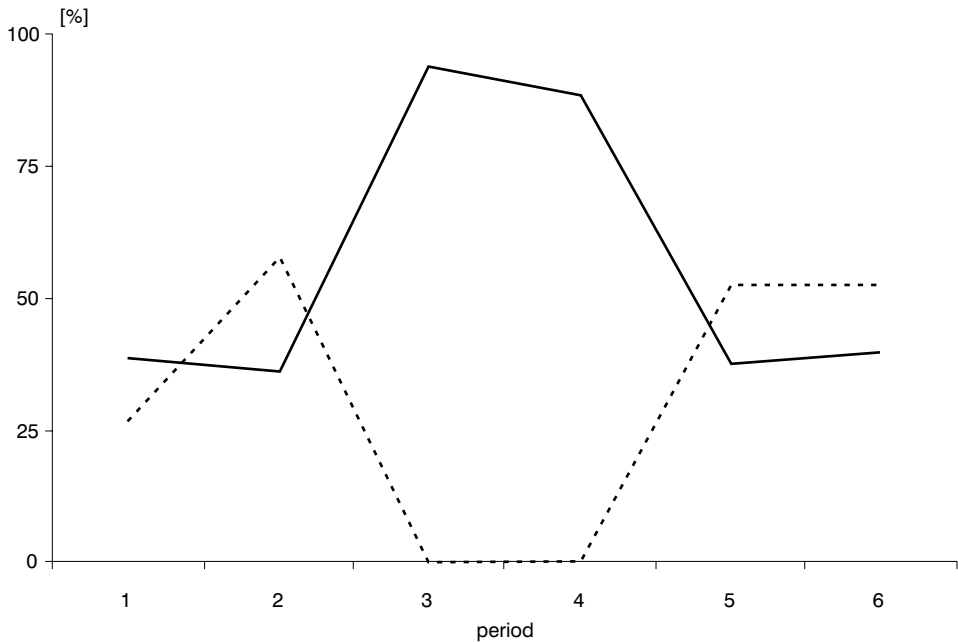
- fallows: similarly with low and high vegetation;
- drainage ditch and small water-bodies;
- field-paths: green and sandy;
- field boundary strips.

In the after-mentioned analysis there were omitted categories in which storks had not been found. They were: orchards, farmers' backyards and little ponds.

On purpose to enlarge sample size and increase the power of tests results from both years had been sum up. The frequency of finding storks on each foraging sites and their presence according to the height of vegetation were analysed. The attention was also paid on birds foraging during the agricultural practice. The statistics were prepared in Simstat for Windows software.

## Results

A high preference to forage on the meadows and fields in relation to other available habitats was found. In 238 cases (60.7%) storks were foraging on meadows and pastures, while on fields in 129 cases (32.9%) (Fig. 1) The rest of foraging sites were chosen accidentally: in 14 cases (3.6%) birds were found foraging in drainage ditches with the water, in 6 cases (1.5%) on field boundary strips, in 3 cases (0.8%) on fallows, and once (0.3%) on the field path and on the pile of dung.



**Fig. 1.** Percentage of the presence of White Storks foraging on the farmland and meadows in particular periods of the research

Explanations: dashed line – arable fields; continuous line – meadows. Number of periods – see Methods

The highest diversity in choosing the foraging sites was found in first two decades of this research (period 1). This period characterised in low vegetation both on the meadows and farmland or it's lack in case of ploughed fields. In this period meadows and pastures were slightly dominant (39.6%) in storks' choice, then the farmland (27.1%), ditches with water (14.6%), field boundary strips (10.4%), fallows (6.3%) and in just one case (2.1%) field path. These differences are statistically significant ( $\chi^2 = 28.75$ ,  $df = 5$ ,  $P < 0.0001$ ). During this period no foraging in the presence of agricultural machinery was found.

In the following two decades (period 2), which means until the beginning of first haymaking, storks preferred farmland (59%) to meadows (37.2%). Other foraging sites, such as ditches with water, boundary strips and dung pile were used only accidentally (1.3% each). These differences are statistically significant ( $\chi^2 = 111.74$ ,  $df = 4$ ,  $P < 0.0001$ ). In that time in 47.4% of cases storks forage in the presence of agricultural machinery.

In the following two decades (period 3) storks forage almost only on the meadows (97.4%). Only in 2 cases (2.6%) storks that forage in ditches with water were recorded. This difference is statistically significant ( $\chi^2 = 70.205$ ,  $df = 1$ ,  $P < 0.0001$ ). During this time in 28.2 % of cases storks forage near the agricultural machinery.

Period 4 only slightly differs from the previous one, where meadows are almost the only foraging site of storks (93.9%). The second category make drainage ditches with water (6.1%). This difference is statistically significant ( $\chi^2 = 50.969$ ,  $df = 1$ ,  $P < 0.0001$ ). In 90.9% of cases storks forage without the presence of the agricultural machinery. By this time from the majority of the meadows the hay had been removed.

During the next 2 decades (period 5) beside the meadows (58.3%) storks forage eagerly on the farmland (41.7%). This difference is statistically significant ( $\chi^2 = 1.333$ ,  $df = 1$ ,  $P = 0.5777$ ). No other foraging sites were found during this period. In 62.5% of cases stork forage in the presence of the agricultural machinery.

In period 6 because of the agricultural practice main foraging sites were the farmland – mostly fallows and freshly ploughed fields (56.8%). Besides, birds were found only on meadows (43.2%). This difference is not statistically significant ( $\chi^2 = 1.3514$ ,  $df = 1$ ,  $P = 0.5722$ ). In this time in 35.1% of cases storks forage in the presence of the agricultural machinery and almost every time it referred to farmland.

On the meadows in 82.4% of cases birds forage without the presence of the agricultural machinery, contrary to the farmland where in 61.2% of cases storks forage during the machinery work (Fig. 2). This result was statistically significant ( $\chi^2 = 69.97$ ,  $P < 0.0001$ ).

The difference in selection farmland and meadows as foraging sites by the storks during the whole research is statistically significant ( $\chi^2 = 32.373$ ;  $df = 1$ ;  $P < 0.0001$ ) what gets out of preference of the foraging sites during periods 3 and 4 when in storks' choice are almost only meadows, and no fields. When these two periods are excluded, there is no significant differences.

Storks that forage on the farmland most frequently chose ploughed fields without the vegetation (60.5%), by half less frequently they were observed on the

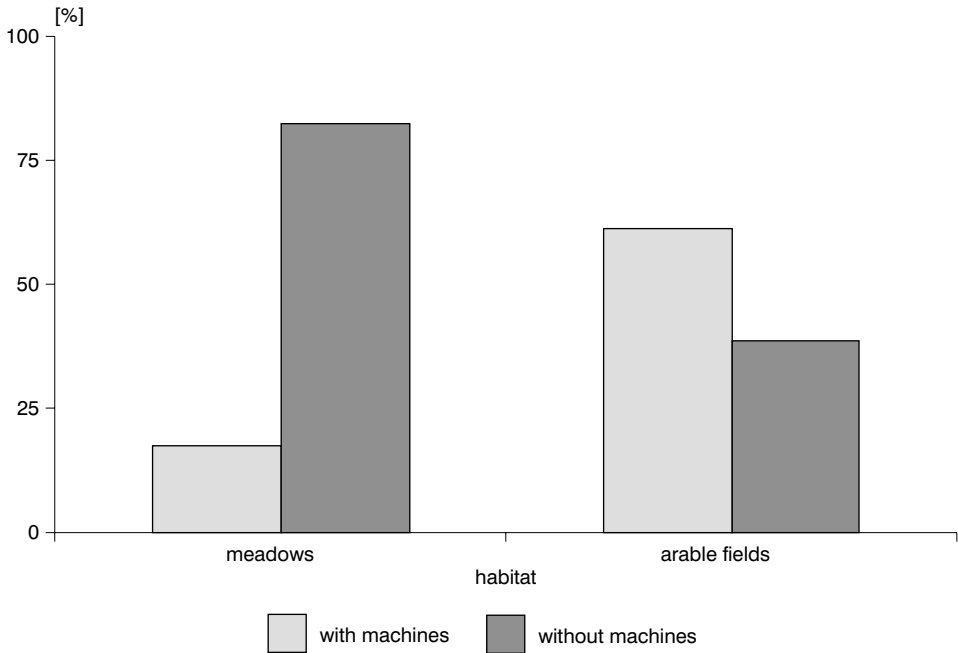


Fig. 2. Percentage distribution of the number of records of White Storks that forage in the presence of the agricultural machinery and without them on the two most frequently chosen foraging sites

fallows (29.5%) and occasionally on the fields with young vegetation (8.5%) and foraging in high vegetation (1.6%). The differences shown here are statistically significant ( $\chi^2 = 108.30$ ,  $df = 3$ ,  $P < 0.0001$ ). The storks which forage on the fields with vegetation were found only on these with growing cereal ( $n = 10$ ) and young potatoes ( $n = 3$ ), but in the second case only in the presence of the agricultural machinery.

From among the meadows most willingly were chosen foraging sites with parted hay, most frequently in the mowing day or before the grass had finally dried (57.1%). Meadows with the low grass (early in the spring and after the haymaking) were more often used as the foraging sites by the storks than the meadows with the high grass (26.9% and 21.4% respectively). These differences are statistically significant ( $\chi^2 = 37.117$ ,  $df = 2$ ,  $P < 0.0001$ ).

## Discussion

High diversity of the White Storks' foraging sites during the first two decades of the research is probably due to low number of potential prey in the optimal foraging sites with simultaneous availability of numerous other habitats in view of low vegetation on the fields with the winter crops and in drainage ditches or it's lack in case of the freshly ploughed fields. There is also observed pretty frequent using of farmland, most frequently near the meadows. Although there are 5 times more

cropland than meadows and pastures in the study area, meadows were major foraging sites for these birds, though. During the first two decades of the research birds changed foraging sites frequently, more than once during a dozen or so minutes, shifting from a meadow to field which was being ploughed, field boundary strips, field path and drainage ditches. On the respective areas birds stopped just for a while, performing single attacks, or just search potential victims. In view of methodology taken, such frequent and short term changes of foraging sites were not included into statistics. Later in the season there were no such frequent changes observed – storks forage for a long time in one habitat. During the second period there is clearly seen a higher storks preference to forage on the fields than on meadows, what is probably due to growing grass on the meadows and difficulties in hunting. Meadows again become attractive when the haymaking starts. Other habitats are visited by storks only occasionally. Pinowski et al. (1991) between 25.05 and 22.06 showed lower storks' effectiveness in catching victims on mowed meadows and pastures as compared with mowed meadows and cereal upturned. However, they could hunt with success also in other habitats. During third and fourth period of research storks were not seen on the farmland which are then covered with high vegetation and there aren't conducted agrotechnical works then. In this time almost only foraging sites for storks are meadows where haymaking occurs then. However, beyond the research area storks were also observed foraging on flowering cereal almost as high as they. The fields were seen in the neighbourhood of a meadow. Storks especially eagerly visited meadows during grass cutting or during few days after, when cut grass or hay hadn't been removed yet. Meadows stop being attractive for storks most frequently few days after the hay collecting, when the grass is very shortly cut and therefore is no longer a shelter for the potential prey. During the fifth period of research, when the first agricultural practice start, storks eagerly forage in this habitat, as well as on the meadows. Similarly, during the sixth period, fields were eagerly chosen as foraging sites, but only a little more frequently than meadows. Between 23.06 and 22.07 Pinowski et al. (1991) showed the highest effectiveness in catching prey on moved meadows and fields, unmowed meadows and pastures and on the wetlands (meadows, watercourses and water reservoirs). After 23<sup>rd</sup> July storks caught prey with success in most habitats, what similarly to spring issues from their availability.

The preferences in choosing the foraging sites of the White Stork univocally indicate on habitats which need protection. Undoubtedly, meadows, especially wet ones should be protected as a source of diverse and rich storks diet. These habitats are used during the whole time when storks presence in Poland. However, when the convenient occasions occur such as agricultural practice, storks forage on the fields eagerly then. Changes in agriculture have direct impact on storks number (Dallinga & Schoenmakers 1987). Although farmland are visited also beyond time of field works, are not a source of properly diverse and rich feeding base. Although birds foraged in these habitats, they didn't stay there for long and foraged mostly in the presence of the agricultural machinery, which work made the hunting easier. Benstead et al. (1999) indicated also on positive impact of the grazing on the White Stork population, however in this region situation of storks foraging in cat-

the company hadn't been observed, what is probably connected with the reduction of stock and grazing of single individuals often near the farm. Storks foraging near the buildings were observed in subsequent years (unpublished obs.), but at dawn when they weren't frightened away by the inhabitants. It can confirm the thesis about the wealth of victims in such foraging sites (Bunalski 1999, Tryjanowski et al. 2005).

### **Acknowledgements**

I would like to thank Marta Borowiec, Piotr Tryjanowski and anonymous reviewer for the remarks to this text.

### **References**

- Benstead P.J., José P.V., Joyce C.B., Wade M. 1999. European Wet Grassland. Guidelines for management and restoration. RSPB, Sandy.
- Bunalski M. 1999. Die Blatthornkäfer Mitteleuropas *Coleoptera*, *Scarabaeoidea*: Bestimmung – Verbreitung – Ökologie. Slamka, Bratislava.
- Dallinga J.H., Schoenmakers S. 1987. Regional decrease in the number of White Storks (*Ciconia c. ciconia*) in relation to food resources. *Col. Waterbirds* 10: 167–177.
- Jakubiec Z., Szymoński P. 2000. Bociany i boćki. PTPP “pro Natura”, Wrocław.
- Kania W. 1985. Results of bird ringing in Poland. Migrations of white stork *Ciconia ciconia*. *Acta Orn.* 21: 1–41.
- Pinowska B., Pinowski J. 1989. Feeding ecology and diet of the White Stork *Ciconia ciconia* in Poland. In: Rheinwald G., Ogden J., Schulz H. (eds.) *Weißstorch – White Stork*. Proc. I Int. Stork Conserv. Symp. Schriftenreihe des DDA 10, Bonn: 381–396.
- Pinowski J., Pinowska B., de Graaf R., Visser J., Dziurdzik B. 1991. Influence of feeding habitat on prey capture rate and diet composition of White Stork *Ciconia ciconia* (L.). *Studia Nat.* A 37: 59–85.
- Rachel M. 2004. [White Stork (*Ciconia ciconia*) in Kępno district.] *Zesz. Powiat. (Kępno)* 1: 49–57.
- Tryjanowski P., Jerzak L., Radkiewicz J. 2005. Effect of Water Level and Livestock on the Productivity and Numbers of Breeding White Storks. *Waterbirds* 28: 378–382.
- Tryjanowski P., Kuźniak S. 2002. Population size and productivity of the White Stork *Ciconia ciconia* in relation to Common Vole *Microtus arvalis* density. *Ardea* 90: 213–217.

