



Night roosts, flocking behaviour and habitat use of the non-breeding fraction and migrating White Storks *Ciconia ciconia* in the Wielkopolska region (SW Poland)

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ABSTRACT: We present data on some aspects of the non-breeding population of White Stork in south-western Poland. The main research aims of this study were to describe the temporal patterns of occurrence of non-breeding flocks of White Storks, to identify main foraging habitats utilized by non-breeding storks and describe night roost sites. The following data: date, number of birds, general behaviour (e.g. roosting, foraging), habitat, and in the case of night roost also information on roosting sites, were collected in south-western Poland.

During the whole study period, 3309 White Storks were recorded: 98 individuals (3%) were recorded during spring migration, 2352 (71%) were classified as the non-breeding fraction and finally over 24% were observed at the start or during the autumn migration. Moreover, 724 White Storks were observed at night roost sites and over 96% of storks roosted communally; the mean roosting group size was 10.3 ± 9.3 with a maximum of 41 birds roosting on a single tree. The most important night roost sites were free standing, mainly dead trees, which hosted the largest number of birds – 417 (57.7%), followed by Scots Pine forests – 292 (40.3%). Among other sites used for roosting by storks were electric poles – 9 (1.2%), railway poles and hunting platforms (0.8%). The non-breeders foraged in a wide range of habitats; however most observations and the largest number of birds were recorded at the sewage farm and at grassland areas including meadows and pastures. Among 11 White Storks of known age ringed and later resighted as non-breeders, eight (72%) were in their 4th calendar year of life, two were in their 3rd calendar year and one in its 2nd calendar year. We conclude that the study on the relationship between breeding and the non-breeding populations offers new data to better understand the ecology of the White Stork.

KEY WORDS: non-breeding fraction, spring migration, autumn migration, night roosts, habitat use.

Introduction

Traditionally, for a large number of bird species the non-breeding population is the least explored aspect of the life cycle. There is no doubt that this phase has a strong influence on several aspects of a species' ecology and dynamics, both at the population and the individual level (Cody 1985, Newton 1989, Sæther et al. 2005). Several authors have stressed the potential impact of the non-breeding period on population productivity, dynamics, strategy of habitat selection, individual lifetime reproduction as well as on conservation practices (Cody 1985, Newton 1989, Goriup & Schulz 1991). Traditionally, non-breeders are defined as the fraction of the species which are present within the breeding range during the breeding period, but show no signs of reproductive behaviour. In the case of some species, including the White Stork, this period is termed "summering" (Van den Bossche 2002).

According to Burnhauser (1983), even about two thirds of all the White Stork population belongs to the non-breeding fraction. Despite a large body of published literature, the non-breeding period seems to be the poorest explored part of the ecology of the White Stork. This species is a long distance migrant which migrates to wintering grounds located in southern and central Africa, and uses well defined migration routes (e.g. Kania 1985, 2006, Schulz 1998, Van den Bossche 2002). White Stork is a long lived bird with a prolonged delay of sexual maturity which is reached after three to four years (Schulz 1998). Recently performed systematic field studies on stopover sites and migratory routes in Israel indicate that a large fraction of immature White Storks depart from the wintering grounds in Africa and cross Israel to summer elsewhere in Europe, Turkey and Israel (Van den Bossche 2002). This result provokes several questions: why do immature storks take a long and risky journey from their winter quarters to Europe? How do non-breeders behave during summering? What foraging habitats are selected during the non-breeding period? Data about the behaviour of the non-breeding fraction of White Storks during summering are rare and, to our knowledge, there is no study concerning non-breeding storks in Europe.

The Polish White Stork population – probably 50,000–55,000 breeding pairs in 2004 (Guziak & Jakubiec 2006) – is the largest (about 20% of the) world population of this species, moreover it is generally increasing (Jakubiec & Guziak 1998, Schulz 1998, Guziak & Jakubiec 2006). Despite a large (e.g. Kopyj 2004) and increasing number of studies performed on this species, information about non-breeding White Storks are occasional and dispersed in the literature; and a systematic study devoted to the ecology of the non-breeding period is still lacking. Among the last, methodological important papers about White Storks researches in Poland, only Profus (1994) suggested collecting of the data about non-breeding birds. Lack of such suggestion in the other such papers (Indykiewicz 2004, Jakubiec 2004, Guziak 2006, Guziak & Jakubiec 2006) is another reason that this data are omitted in the field job and publications.

In this paper we present data on some aspects of the non-breeding period of the White Stork in South-Western Poland. The main research aims of this study were to describe temporal patterns of occurrence of non-breeding flocks of White

Storks, to identify the main foraging habitats utilized by non-breeding storks, to describe night roost sites and, finally, we try to answer the question, is there a relationship between the use of a summering site and the selection of a future breeding site?

Study area and methods

Our data was collected in south-western Poland, in the south-eastern part of the Wielkopolska region: in the Ostrów Wielkopolski district [51°30'–51°49'N, 17°31'–18°11'E] in 1993–2004 and near Wilkowyja village in the Jarocin district in 2003–2004 [52°01'–52°02'W, 17°32'–17°33'E]. We collected data on flocks and roosts of non-breeding and migrating White Storks during surveys of storks and also during a wide range of field studies performed to study other bird species e.g. shrikes, waders and a general ornithological evaluation of the study area. The most intensive observations were performed on three sites:

- 1) a large (5 km²) sewage farm near Rąbczyn village close to the town of Ostrów Wielkopolski including partially flooded meadows with regular mowing, surrounded by arable fields and a Scots Pine *Pinus sylvestris* forest;
- 2) the eastern part of the Barycz River Valley (100 km²) near the town of Odolanów in the Ostrów Wielkopolski district, mostly in the “Dolina Baryczy” (“Barycz Valley”) Landscape Park and Special Protected Area, covered by mixed extensive farmland habitats with a high proportion both dry and wet regularly mown meadows, pasture, arable fields and a complex of fish ponds, with a night roost near Garki village, from which a paper on the food of non-breeding birds was published (Antczak et al. 2002), and another night roost on a similar oak tree north of Bogufałów village, on the north-eastern edge of the valley;
- 3) a large polder on the Lutynia river near Wilkowyja village (Jarocin district), regularly, but briefly flooded as a form of agricultural practice and covered by different stages of grass vegetation during drier periods.

We collected the following data: date, number of birds, general behaviour (e.g. roosting, foraging), habitat, in the case of a night roost we also described roosting sites. During observations, flocks and single storks were carefully checked for ringed birds using telescopes. In analyses we used only data of storks feeding or resting on the ground.

Breeding population and ringing effort

During the period 1994–2004 in the Ostrów Wielkopolski district the data on the breeding population of the White Stork – including breeding success, productivity, intensive ringing of nestlings (1773 nestlings, up to 95% of all nestlings in this area in some years), resightings of ringed birds and return rates were collected (for details see Dolata 2003, Chernetsov et al. 2006). The breeding density in the Ostrów Wielkopolski district during the VIth International White Stork Census in 2004 was 9.1 breeding pairs/100 km² (Dolata unpubl.) and was significantly lower than the average for Poland that year (16.8 breeding pairs/100 km²), but similar to

densities in Western Poland (Guziak & Jakubiec 2006). Breeding densities in some parts of the Ostrów Wielkopolski district were higher, especially in the eastern Barycz River Valley, e.g. 16.5–18.2 breeding pairs/100 km² in 2000–2002 (Dolata 2003). Reproductive parameters are in the high category (Dolata 2003 and unpubl.), similar to other areas of Poland (Jakubiec & Guziak 1998, Guziak & Jakubiec 2006).

Results

Timing of spring migration, non-breeding fraction and autumn migration

On the study area during the whole study period, 3309 White Storks were recorded. The temporal pattern of occurrence of White Storks on the study area is shown in Figure 1. Among this number, 98 individuals (3%) were recorded during spring migration, 2352 (71%) were classified as the non-breeding fraction and finally over 24% were observed at the start of (including pre-migration flocking) or during the autumn migration.

The first flocks of White Storks were noted during the middle third of April. The spring migration was characterized by a low total number of observed birds as well as flocks. The non-breeding fraction were classified as birds which, during the entire breeding period (beginning of May until the end of July), did not use nests (i.e. we observed no flights to nests during longer observation), but were recorded as foraging or mainly night roosting in groups. The autumn migration was classified as the period from the first third of August, and the last storks were recorded at the beginning of September, similar to results in Jakubiec (1991) and Tomiałojć and Stawarczyk (2003).

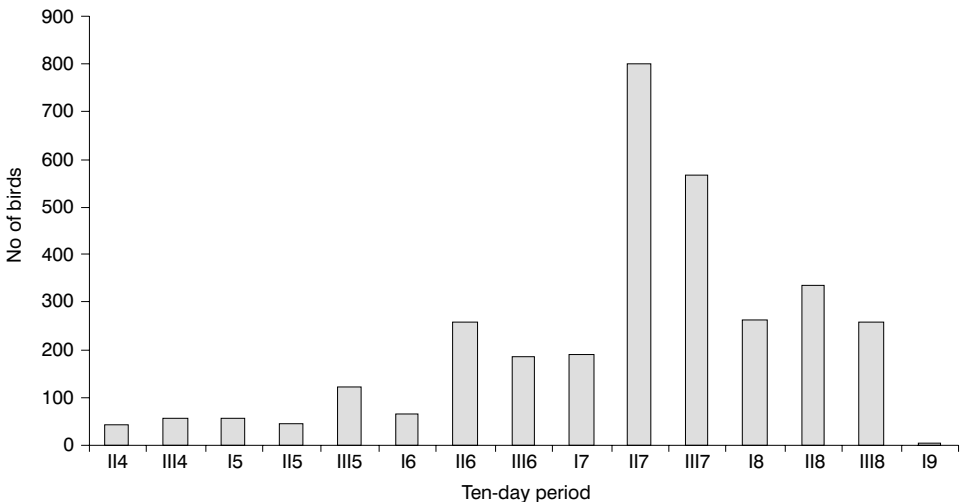


Fig. 1. Total number of White Storks recorded in the ten-day periods. All years of study pooled

Occurrence of non-breeding White Storks

During the research period we recorded a total of 2352 White Storks which were classified as non-breeders. The non-breeding fraction was observed each year for 11 years, however, numbers varied between years (Fig. 2). In 1993, 1994 and 2000 we noted the greatest numbers of individuals; however the intensity of observation also varied between years. The largest flocks of non-breeders during the breeding season were observed in 1994 on the Rąbczyn sewage farm: 55, 62, ca. 40, 146 and 50 White Storks on the 12th, 16th, 26th, 28th and 29th July respectively and only 30 birds on the 1st August. This brief peak on 28th July may have been connected with early migrating birds.

Night roosts and roosting behaviour

During 91 observational visits, 724 White Storks were observed at night roost sites. Birds at communal roosts were first recorded in the first third of May (7th May 1993), the last individuals were recorded at the end of August (26th August 1996). The communal roosts were mainly used by non-breeding birds but in August and even at the end of autumn migration and departure, migrating storks were also noted at roosts. The most important night roost sites were free standing, mainly dead trees, which hosted the largest number of birds – 417 (57.7%), followed by Scots Pine forests – 292 (40.3%). Among other sites used for roosting by Storks were electric poles – 9

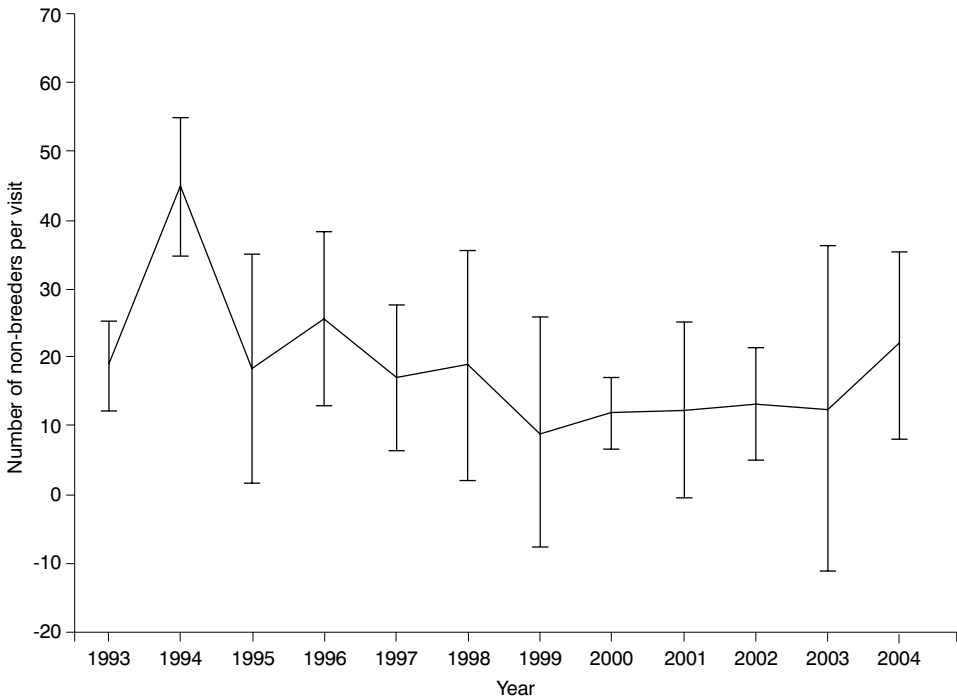


Fig. 2. Year to year changes in the mean numbers of non-breeding White Storks recorded during the study period. Bars denotes $\pm 95\%$ CL

(1.2%), railway poles and hunting platforms (0.8 %). The trees used for roosts were: oaks *Quercus* sp., poplars *Populus* sp., Alders *Alnus glutinosa* and Scots Pines. All of the deciduous trees were dead or partly dead, without or with only a small number of leaves, and offered a good place for landing on and taking off to storks. For the same reason only the Scots Pines on the edge of the forest were used.

In total, six regularly used night roosts were recorded on the study area. Not all roosts were used during the whole study period. A night roost located near the Rąbczyn sewage farm was used for 10 of the 11 years of our studies (years 1991–2001) and storks roosted in the Scots Pine forest. Additionally, the existence of a non-breeding flock here at least a few years before was mentioned by Michalak (1988). Another night roost occurred on a single old oak (and rarely on alders and poplars in close proximity) near Garki village in the eastern Barycz River Valley and was used during at least six seasons (1999–2004) and the two years (2005–2006) subsequent to our study period, but in smaller numbers (M. Antczak, A. Dajczer, P. Tryjanowski, unpubl. data).

Among 724 White Storks observed night roosting over 96% roosted communally; solitary roosting individuals were recorded for 27 observations (29.6% of the total number of observational visits and 3.7% of the total number of observed birds). One ringed stork was recorded roosting in different, but nearby sites (on the edge of the same foraging area) on consecutive nights.

The mean roosting group was 10.3 ± 9.3 SD with a maximum number of 41 roosting birds recorded on single tree (oak near Garki village, 1st August 2001) and a maximum of 47 birds on one roost the same day (this oak plus four birds on a nearby Alder and two birds on two nearby poplars) (Fig. 3). No significant differences were recorded between the mean size of roosting groups from the sewage farm, polder and river valley (Kruskal-Wallis test $H_{(2,70)} = 0.67$, $P = 0.71$).

Storks arrived at roosting sites singly or in small groups (mean 2.07 ± 2.88 , range 1 to 22). The mean size of groups arriving at roosts located near the sewage farm appeared higher than in the Barycz River Valley (mean 3.14 ± 4.82 vs. 1.59 ± 1.09 , respectively), however this difference was not significant (Mann-Whitney test $Z = -0.76$, $P = 0.44$). In four cases, single Grey Herons *Ardea cinerea* roosted together with White Storks.

White Storks arrived at roosts up to hour before sunset but the majority of birds arrived a few minutes after sunset. The storks landed directly on the roost trees or after a few circuits. After landing, the majority of birds displayed an up-and-down display combined with bill clattering. Such behaviour was frequently noted on the communal roost and was widespread among individuals. In some cases we noted aggressive behaviour when one bird flushed another one from its roosting perch, especially then a larger number of birds roosted.

In only one season (2002) a White Stork (probably one individual) built a small nest on a redundant electric pole near Przygodzice in the Barycz River Valley. This nest was used for night roosting by the same bird, which was ringed as a nestling in 1999 in Przygodzice village (1.8 km E from the roosting site) and recorded in 2004 as a successful breeder with a new nest (1.5 km S from its natal nest and 2 km SW from roosting site in 2002).

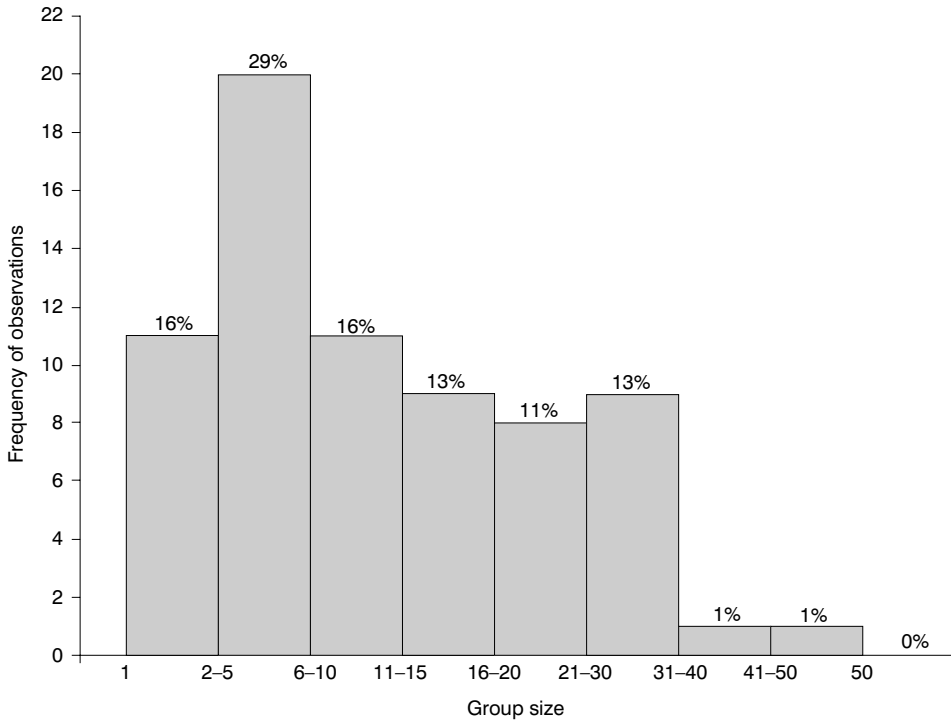


Fig. 3. Group size of roosting White Storks recorded at well established communal night roosts in the study area, all years and all roosts combined

Habitat use by summering White Storks

The non-breeders foraged in a wide range of habitats; however most observations and the largest number of birds were recorded at the sewage farm and at grassland areas including meadows and pastures. We noted 1898 non-breeding storks during 111 observational visits. Significant differences were found in the flock size (Kruskal-Wallis test $H_{(3,111)} = 8.72$, $P = 0.03$), the lowest mean flock size was recorded in the Barycz River Valley where birds foraged on meadows and pastures,

Table 1. Habitat use by non-breeding White Storks in the study area. R – sewage farm near Rąbczyn, BV – Barycz River Valley, J – polder near Jarocin

| Habitat | Mean flock size | SD | Lower 95% CL | Upper 95% CL | N of flocks | N of individuals |
|----------------------|-----------------|------|--------------|--------------|-------------|------------------|
| Sewage meadows (R) | 17.21 | 2.11 | 13.01 | 21.41 | 79 | 1360 |
| Grassland areas (BV) | 11.81 | 4.01 | 3.86 | 19.77 | 22 | 228 |
| Polder (J) | 21.66 | 7.68 | 6.43 | 36.89 | 6 | 130 |
| Ploughed fields | 45.25 | 9.40 | 26.59 | 63.90 | 4 | 180 |
| Total | – | – | – | – | 111 | 1898 |

the highest mean flock size was noted on polders and ploughed fields as well as at the sewage farm. However there was a large bias towards observation of flocks, storks hardly used the sewage farm and meadows as their main foraging areas (Table 1).

Age and origin of non-breeders

Among 11 White Storks of known age ringed and later resighted as non-breeders – nine were recorded in the study area and two elsewhere in the Wielkopolska region (T. Iciek, P. Wylegała), including one ringed as nestling in our study area. Eight (72%) were in their 4th calendar year of life, two were in their 3rd calendar year of life, and one in its 2nd calendar year of life. Among eight non-breeders recorded in the study area, three were ringed as nestlings in our study area (0.5, 0.5 and 1.8 km from the natal nest) and five were birds ringed outside the study area (up to 330.6 and 331.3 km from the natal nests). All three birds which hatched in the study plot and were later located as non-breeders were resighted as breeders in subsequent years, including one breeding 26.7 km from the natal nest. It should be taken into account that these short distances between place of birth and place of resighting are likely biased; no doubt connected with the high ringing and resighting activity in our study area and the scarcity of such activities elsewhere in Poland (see also Dolata 1999, Kania 2006).

Discussion

The wintering immature White Storks have three main options where they spend the subsequent summer period: firstly they could stay at the major wintering areas or undergo local movements; secondly they could migrate to completely new areas located on the migration route, e.g. Israel and the rest of the Middle East; or finally they could try to reach the breeding grounds in Europe (cf. Van den Bossche et al. 2002).

As shown by recent studies as well as by older papers, a portion of non-breeders stayed over summer in the wintering areas but the majority of these birds were in poor condition (Maclean et al. 1973). Recent intensive field studies conducted on stopover sites in Israel showed that a large part of the non-breeding stork population migrate to Europe and a substantial number of non-breeders summer in Israel (Van den Bossche et al. 2002).

Non-breeding White Storks occurred regularly in the study area. Some feeding and roost sites were used every year; however numbers varied greatly between years. This result is in contrast to the contemporary ornithological monograph of the Wielkopolska region (of which our study area is a small part), in which Ptaszyk (2000) stated that non-breeding White Storks occurred in different parts of the region irregularly, especially large numbers were noted 3 or 4 years following high breeding success years, for example following good breeding years in 1994 and 1995 (Kuźniak 1995, Kosiński 1998) large flocks were seen in two sites near Poznań in 1998. In our study one of the three years with the largest number of non-breeding Storks was year 2000, when birds in their 4th calendar year of life should be the ma-

majority in non-breeding flocks (see above), but in 1997 White Storks had an extremely low breeding success in the study area (Dolata unpubl.), adjacent districts (Kosiński 1998, Witkowski & Orłowska 2002), across Poland (e.g. Profus & Chromik 2001) and Germany as well (Griesohn-Pflieger 1997). Detailed data about long-term breeding success and records of non-breeding flocks in local populations in Wielkopolska, published by Kuźniak (1994) and Ptaszyk (1994) show no significant correlation between high breeding success in some seasons and the size of non-breeding flocks 3 or 4 years later in the same area. There are a few factors which might influence the failure to detect such relationship. The first is the mixed age structure of non-breeding flocks: they consisted of birds in 3rd and 4th calendar years of life, but also 2nd year birds (see results above) and probably older birds, which may still not reproduce in their 6th and 7th calendar year of life (Cramp, Simmons 1977) or which joined non-breeding flocks after losing their broods. Secondly, the breeding success of local populations might vary strongly in space and time (Griesohn-Pflieger 1997, Profus & Chromik 2001, Kosiński 1998, Witkowski & Orłowska 2002, Indykiewicz 2006). Finally, the high mortality of young birds (e.g. Schulz 1998, Schaub et al. 2005) as well as the fact that an important portion of White Storks spend their summer a few hundred or thousand kilometers from their natal area (Bairlein 1981, Jeni et al. 1991, Kania 2006, this paper).

In the majority of papers, including those of a more general character, the occurrence as well as the ecology of non-breeding White Storks is completely neglected (e.g. Bogucki 1981, 1994, Jakubiec 1991, Tranda 1992, Mielczarek 1993, Jakubiec & Guziak 1998, Indykiewicz 1998, 2004, Guziak & Jakubiec 2006). In a few general ornithological publications there are some notes about records of non-breeding White Storks, e.g. large flocks (up to a few hundred birds, but very rarely) in the wet river valleys such as Biebrza and Narew in North-Eastern Poland (Dyrz et al. 1972, Gromadzki et al. 1994, Pugacewicz 1995, 2000, Górecki & Lewartowski 1997, Tomiałojć & Stawarczyk 2003). This is supported by estimations of the non-breeding fraction given by Pugacewicz (2000) for the Biebrza River Valley of up to 2000 birds and in the whole Northern Podlasie region about 4000–5000 individuals.

Lesser flocks (up to few dozen) were noted in western Poland, e.g. in the Odra, Warta and Noteć river valleys (Bednorz & Kupczyk 1995, Mleczak 1995), especially in the Warta river confluence with the Odra river (Jermaczek et al. 1990, 1993, Jakubiec & Szymoński 2000). Regular flocks of non-breeders were recorded on sewage farms, e.g. large flocks in Wrocław in South-Western Poland (Lontkowski et al. 1988, Słychan 1996) and smaller flocks near Wolsztyn in Western Poland (Mączkowski et al. 1991, P. Tryjanowski pers. com.). A few records of non-breeding flocks, up to 76 White Storks, were reported from the Świętokrzyskie Mountains and their vicinity region in Central Poland (Kusiak 2005), but in this region regular non-breeding flocks of up to 20 were observed in the Nida River Valley (Polak & Wilniewicz 2001).

There is a problem with clear definition of the summering period as well as clearly distinguishing between non-breeders and breeders. Libbert (1954) and Schmidt (1987) defined summering as the period from 1 April to 15 August. In the case of the eastern population, Van den Bossche et al. (2002) suggested that only

data from the beginning of June to mid July should be considered. In our analyses we considered the beginning of May to the end of July as the summering period according to phenological data from the breeding populations in western Poland (Mrugasiewicz 1972, Profus 1991, Radkiewicz 1992, Kuźniak 1994, Ptaszyk 1994a, Kosicki et al. 2004) as well as unpublished data from the studied population (Dolata unpubl.), where the majority of breeding adults arrive from the end of March until the end of April and young and adults leave the nests from the end of July until the beginning of September. In this paper our separation of breeding and non-breeding and migration periods closely matches the classification of Jakubiec (1991) and Tomiałojć & Stawarczyk (2003), who assumed – according to observations of passage birds and arrivals to and departures from breeding sites – a spring migration period of White Stork across Poland during the last third of March and during April while August and September were identified as a period of autumn migration.

From the behavioural perspective, non-breeders should be easily distinguishable by their behaviour, since non-breeders do not occupy nests (exceptionally may build one, see above), forage in small parties (but sometimes together with breeders from neighboring nests, Dolata unpubl.) and use night roosts which are large distances from active nests whilst breeding adults spend nights at or in close proximity to nests (Dolata & Antczak unpubl.).

The age structure of non-breeders from Western Poland is strongly skewed towards birds in their third and fourth calendar year, whereas we recorded at least one second year stork. In the western population, based on ringing recoveries, Bairlein (1981) and others (Libbert 1954, Michard et al. 1995, Tortosa et al. 1995) estimated that at least 25–31% of second year storks summered in their natal areas. Moreover 70% of birds summered closer than 600 km from their birth place (Bairlein 1981, Jenni et al. 1991). These differences are not clear and need further research but different distances from breeding and wintering grounds as well as different conditions e.g. climate or feeding on migration routes as well as differences in body condition between age classes of non-breeders might play an important role. The majority of summering storks in Israel were in their second year (Van den Bossche et al. 2002).

The communal roosting of White Storks has been described by several authors (e.g. Kahl 1972) and our study confirmed these observations. Probably the communal roosting is a safety strategy, but might provide other benefits such as information on good foraging grounds including the use of public information (Ward & Zahavi 1973, Valone 1989, Wagner & Danchin 2003). Among other information from Poland, only Radkiewicz (1971) and Kuźniak (1994) give examples of night roosts used by White Storks. In these cases they used Scots Pine forest or old and large poplars and willows. It is noteworthy that several night roosts sites might be used in consecutive seasons both by non-breeders as well as by migrating storks, just as on our study area. It seems that the main characteristics of such long term night roosts are: proximity to feeding grounds and the presence of old trees. Occasionally, non-breeding White Storks build roosting nests, in the whole study period we noted one example of such behaviour, similar observations are given by Mrugasiewicz (1972) and Kuźniak (1994).

White Storks are opportunistic feeders and use a wide range of habitats and easily exploit new sources and habitats (e.g. Schultz 1998, Antczak et al. 2002, Kosicki et al. 2006). Non-breeders mainly foraged on sewage farms and grassland areas in our study area. The observational data from areas elsewhere in Poland, especially if the largest concentrations were in wet river valleys and sewage farms, confirm this result (see review of summering habitats below). The differences in the size of foraging flocks revealed in this study might be caused by a few reasons. Firstly, the sewage farms and polders might be especially rich in potential prey such as earthworms and insects and the total density of prey might be higher than in the drier habitats such as meadows and pastures, especially during the summer. Detailed analysis of food composition of non-breeders from the Barycz River Valley showed that both insects and voles were important components of the diet and the amount of aquatic animals was minimal (Antczak et al. 2002). This may be caused by the fact that in comparison to breeders, non-breeding storks have much more time for foraging and thus apply more time consuming methods of hunting e.g. lurking for voles near burrow entrances (Antczak et al. 2002). The majority of storks observed during feeding at the sewage farm foraged in another manner – they quickly walked through the polders and the main prey were earthworms and insects (Antczak & Dolata unpubl.). A detailed comparison of diet of non-breeders foraging in different water conditions should reveal strong differences in diet composition. Despite different origins, the polders and sewage farms should be similar in foraging conditions. In Israel, storks hardly used garbage dumps and fishponds during summering (Van den Bossche 2002). Furthermore in the river valleys the patches of freshly mown meadows are dispersed over a large area and as storks are very mobile they dispersed over a larger area. However, the mean flock size recorded on ploughed fields was high but in this case it will be a partially an artifact due to low sample size, beside the arable fields are suitable for foraging storks only at the end of the summering period.

Among foraging habitats used by non-breeding White Storks in Poland the most important were grassland areas (meadows) in river valleys (e.g. Dyrz et al. 1972, Chmielewski et al. 1993, Gromadzki et al. 1994, Kuźniak 1994, Stajszczyk 1994, Pugacewicz 1995, 2000, Dombrowski 1997, Górecki & Lewartowski 1997, Polak & Wilniewicz 2001, this study). Besides, non-breeders were recorded in various habitats including meadows around natural and eutrophic lakes (Bukański & Jabłoński 1992); sewage farms, meadows and fields (Lontkowski et al. 1988, Mączkowski et al. 1991, Słychan 1996, P. Tryjanowski pers. comm., our study); shallow, semi-natural water reservoirs (Jermaczek et al. 1990, 1993, Jakubiec & Szymoński 2000); fishponds (Hordowski 1990, 1994, Kuźniak 1994) and finally arable fields mainly during or after agricultural practices, e.g. after rape harvest or freshly ploughed fields (Kuźniak 1994, Ptaszyk 1994, this study).

Conservation proposals

During the study period the two roosting sites were abandoned. In the case of one roost the old oak near Boguśwałów was cut down in the winter 2001/2002, with the official permission of the Community Office. Negative reaction on TV and in the

press (Dolata 2001) couldn't change this loss but will maybe help preserve similar sites. The second site was abandoned, along with the adjacent foraging area, after 2001 by non-breeding White Storks due to modernization of the sewage farm in Rąbczyn, including conversion of grassland polders into arable fields, and an increase in roads and built up areas.

For successful conservation of the White Stork, the main foraging habitats as well as roosting sites of the non-breeding fraction should be preserved. Our presented findings indicate that some communal roosts can be used over several seasons and might be hot spots for non-breeders. Such sites are quite easy to identify and suitable old trees among meadows should be under protection, e.g. as nature monuments according to the Polish law Act from 16th April 2004 about nature protection. Important, permanent foraging habitats should be protected as ecological utilities by the same Act. Both these forms of nature protection are quite easy to create: not only by province administration, but also by the Board of Community (*Rada Gminy*), the basic and smallest administrative unit, sometimes more interested in protection of their own nature. Roosting sites in the national forests should be protected by the Administration of National Forests (*Administracja Lasów Państwowych*) in cooperation with province and local administration and ornithologists.

To sum up, we conclude that both the non-breeding fraction and breeding populations of White Stork should be investigated simultaneously on the same areas with the same scheme of data collection as long term projects. No doubt it should shed some light on the relationship between the breeding population and non-breeding fraction and give new information on the ecology of summering White Storks.

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