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Introduction. White Stork *Ciconia ciconia* research in Poland: where we are and where we are going?

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Introduction

The White Stork is the symbol of The Hague in the Netherlands and the unofficial symbol of Poland, where more than 20 percent of European storks breed.

In Western culture the White Stork is a symbol of childbirth. In Victorian times the details of human reproduction were difficult to approach, especially in reply to a child's query of "Where did I come from?". "The stork brought you to us" was the tactic used to avoid discussion of sex. This tale was derived from the once popular superstition that storks were the harbingers of happiness and prosperity. Interestingly, this fable also occurs in the United States and Canada where wild White Storks do not occur.

Population size and distribution

The total number of breeding pairs of the White Stork in Poland has been estimated at 52,500 (Guziak & Jakubiec 2006), i.e. about 20 percent of the World population. Therefore, the first important question is why the White Stork breeds so commonly in Poland? This is important, because formerly this species was also numerous in Western European countries. However, the transformation of the environment, especially by excessive intensification of agriculture, has resulted in a decline of stork populations, and even total extinction in some countries. For this question a good answer is only possible if good data from research projects is

readily to hand. Fortunately, the White Stork has a very long tradition of international censuses, officially started in 1934, repeated every ten years and continued to the current time. Exact results from national censuses were used to compare the situation between countries and regions, as well as to examine what is happening with the White Stork over time. In Poland there is a very long tradition of censusing (Eugieniusz Janota in 1876) this species and the majority of researchers of the White Stork mainly publish data on the distribution and number in a local population (data from the last (2004) census are summarized by Guziak and Jakubiec (2006), in which is also made a comparison to previous censuses at a regional level).

In this book we also include some chapters on this classical problem – what is happening with local populations of the White Stork? The authors focus not only on number and distribution, but also on changes in nest locations and changes in colony size, as well as trying to find environmental factors influencing the ecology of this species. This follows other papers already published by Polish authors (or at least including Polish authors) in international journals. Some, but not all, of these papers are cited in this book. This is because people working on the White Stork in Poland do not always have access to international journals, and because many of them are amateurs.

Population changes in Polish White Storks have been discussed in the following papers. Tryjanowski and Kuźniak (2002) found that the long-term population of the White Stork in the Obra river valley in western Poland fluctuated in close agreement with Common Vole *Microtus arvalis* density. Similarly, the total number of fledglings produced in the population was strongly correlated with vole density. On the other hand, in other river valleys White Storks responded more to water level and livestock farming (Tryjanowski et al. 2005a). For example, in Kłopot colony the number of nesting pairs fluctuated independently of the April and June water level, but correlated with the presence of a local livestock farm. The average number of chicks fledged per pair was negatively correlated with the water level in April, when White Storks chose the breeding area. The White Stork appears to use farming activity rather than water level in making a decision as to where to settle. This result suggests that changes in management practices, which are relatively easily made, may improve demographic parameters of local breeding White Storks. However, generally both the above mentioned papers suggested how important are local environmental conditions for breeding storks. This view is also supported by a short-term study in the Biebrza river valley (Nowakowski 2003). He noted that the White Stork population tended to inhabit the area near the edge of the river valley. Pairs with nests sited up to 100 m from the nearest wet meadows in the river valley had a higher average breeding success in comparison with pairs whose nests were sited farther away. In the nesting territories (an area of 1 km radius around the nest site) cereal crops, meadows, green crops, pasture and wet meadows constituted the greatest proportion of the habitat structure. Moreover, changes in habitat quality are important to help understand uphill shifts in the distribution of the White Stork in Southern Poland (Tryjanowski et al. 2005c).

Migration

Storks spend only a part of their life cycle in the breeding ground, and the rest on migratory routes and in wintering places. Therefore it is not a big surprise that the White Stork population is influenced by conditions outside the breeding areas. Schaub et al. (2005), in an elegant paper based on ring recoveries, showed that survival rates of juvenile and adult White Storks originating from Poland and Germany varied in parallel over time. Thus, variation in primary production at one staging area in the eastern Sahel that is visited from October to November contributed up to 88% of the temporal variation in survival. As the population growth rate of White Storks is very sensitive to changes in survival, variation in primary production in the Sahelian staging area contributed significantly to population changes and is likely to be an important reason for population synchrony. Another paper also provides results that annual changes in the size of the eastern European populations (including Poland) were correlated with: rainfall in the wintering areas in Africa, local weather in the breeding areas just before arrival and in the later part of the breeding season, and regional climate variation (North Atlantic Oscillation) (Sæther et al. 2006). This indicates that weather influences the population fluctuations of White Storks through losses of sexually mature individuals as well as through an effect on the number of individuals that manage to establish themselves in the breeding population. On the other hand, several climate variables reduced the synchrony of the residual variation in population size after accounting for density dependence and demographic stochasticity indicating that these climate variables had a synchronizing effect on population fluctuations. In contrast, other climatic variables acted as desynchronizing agents.

To be honest, we should say that is very difficult to model White Stork population dynamics due to the influence of environmental factors. Tryjanowski et al. (2005b) discussed problems of the relationship between population means and variances of reproductive success, which differed between local populations in eight study sites in Poland. The number of nesting pairs and the average number of chicks fledged per pair fluctuated over time, and the studied populations differed in the variance of both breeding success and number of breeding pairs. The variance of breeding success and the variance of the number of breeding pairs was not correlated with the extent of stable habitats (pasture, meadows, wetlands), other habitats (farmland), or with local population trends over time. Moreover a non-linear symmetrical relationship between annual mean reproductive success and its variance existed but only when considered as the proportion of successful nests. No such relationship existed when success was expressed as the number of fledged chicks. This paper opened a discussion on the problem (Moreno & Polo 2006, Tryjanowski et al. 2006) and it looks a long way to a final conclusion. Additional modelling of population dynamics and their response to environmental variables may be strongly modified by generation time, because the White Stork is a long-lived species (Sæther et al. 2005).

As you can see in the above mentioned papers, the situation of the White Stork in Poland depends also on situation outside of the country, on migratory

routes and in wintering places. Therefore is not a surprise that so much attention was paid to migration, especially to phenology. Because the White Stork is a really charismatic species, recognized by the general public, it is possible to use even data collected by farmers. Ptaszyk et al. (2003) examined several features of the timing and arrival pattern of White Storks in the Poznań province, western Poland during the period 1983–2002. Interestingly, in contrast to studies on passerines, no evidence of a weekend bias to phenological recording was found, and moreover unlike some other species, no effect of population size on recorded arrival date was found. Some aspects of the arrival pattern got earlier over time and first arrival appears to have been about 10 days earlier in the last 20 years than in the previous century. Earlier arrival was associated with warmer spring weather and with a protracted arrival period. However, it is well known that weather conditions change year to year, which is important to stork arriving in Poland in the early spring. Tryjanowski et al. (2004) tested an hypothesis that in years with low April temperatures, i.e. when storks started to breed, the relationship between timing of breeding and success would be absent, meaning that migrants would have no advantage by returning early to their breeding area. Similar to other papers, data collected in western Poland during the period 1983–2002 were used in analyses. Based on local climatological data, years were divided into eight cold spring years and 12 'normal' years. The two groups of years did not differ significantly in population size, but in normal years the arrival date of both parents was earlier. Arrival date strongly influenced (was positively correlated with) date of breeding and (negatively correlated with) breeding success. Therefore, natural selection probably strongly favours birds that return early from the wintering grounds.

Similarly to other species' and regions' phenological studies, the main attention is paid to spring arrival, but the first small analysis exists also for autumn departures from our country (Kosicki et al. 2004). It could be concluded, in simple words, that departures should be studied in more detail in the future.

More general studies

Interestingly, the White Stork was used as an example by Sparks and Tryjanowski (2005) to discuss some methodological considerations in climatology. The storks delivering children are a classical problem in teaching statistics, especially on correlation. Now data on storks are really good and offer a lot of possibilities to explore because researchers (and statisticians especially) like long-term studies. In climatology, but partially true in ecology, three commonly used methods involve (i) correlation with an ever-increasing number of climatic variables, (ii) examining trends through time and (iii) a comparison between two points in time. However, using storks and childbirth as an example a more impassionate and critical examination of findings, the so-called 'eclectic' approach, involving a combination of empirical and conceptual evidence is suggested.

Because of the availability of a good collection of data sets, new statistical methods, new data on White Stork migration (including a chapter published in this

book) and critical discussion on methodological issues (e.g. Wuczyński 2005) the development of new analytical methods will be further explored in the future. The first step in this direction is a new paper on sex-related natal dispersal (Chernetsov et al. 2006). An analysis showed a significant sex-linked bias, i.e. females settled farther from the natal sites than males.

People like storks. However, last spring (2006) people even destroyed nests of this charismatic species because of panic associated with Avian Flu and the potential of finding the flu virus H5N1 in storks' blood. Fortunately after great efforts by ornithologists, medical doctors and nature conservancy organizations the situation now looks better. We are rather optimistic, because other studies on parasites and pathogens suggest that storks are very clean birds. For example Andrzejewska et al. (2004) showed the prevalence of *Toxoplasma gondii* in chicks of wild birds and captive individuals, where *T. gondii* antibodies were detected only from 5.8% of 205 analysed White Stork chicks and 13.6% of 44 analysed adult storks in the zoo. Additionally chicks were examined for the presence of antibodies against *Listeria monocytogenes*, and these were detected in 121 (59%) of 205 chick samples. The probability of *Listeria* antibodies being present increased with chick age; interestingly chicks detected with *Listeria* antibodies were in better condition than those without the bacterium. However, even the presence of *Listeria* antibodies does not suggest that storks are ill. Another example, very popular among researchers, are studies on mites, living both in birds' feathers and within nests. Unfortunately the majority of people link the results with the presence of parasites in nests. However, as in the study by Błoszyk et al. (2005), parasitic mites are very rare, and the main group are coprophilous predatory mites that feed on the eggs and larvae of insects and on nematodes.

In the context of Avian Flu and other diseases the importance of information on White Stork ecology and biology are demonstrated. To prepare effective action it is important to incorporate into epidemiological simulations some very basic, but really modern data. This has been sometimes problematic, because, for example some of the species characteristics are from the Western population in Europe and are not necessary true for the Eastern one.

Presently, with rapid economic changes taking place in Poland following membership of the European Union, the situation for storks may deteriorate drastically. Appropriate action should be taken before it is too late. Therefore we are pleased that in Poland were published papers on the food composition of immature and non-breeding storks (Antczak et al. 2002), brood reduction and parental infanticide (Zieliński 2002) and intrapopulation variation of egg size (Profus et al. 2004), and according to our best knowledge some others are still in preparation. However, even the best science is not sufficient to force species protection but a scientific background is needed to support protection. Examples in this book suggest that it is a really broad field of activity. We want to emphasise the significance of education in the protection of the White Stork for future generations. We also know that White Stork conservation requires international cooperation, based on the exchange of information concerning threats and methods of protection, sharing of knowledge and experience, and also financial support.

Our book

While reading this book you will find articles on really diverse aspects of the ecology of the White Stork. Some of them are outside classical ornithology. However, we decided to incorporate these papers into our book, just to show how varied are current avian studies We hope articles will appeal to both professionals and amateurs. On the other hand, for professionals these may add information to understand White Stork biology and ecology in detail, and in consequence to prepare better conservation programs.

It was very difficult to separate single papers into themed sections. Therefore, we decided to adopt a loose structure and have used as a separator pictures painted by Katarzyna Mokwa. The sections suggest only what is contained in that part of the book, but it is only an informal division.

At the end of this introduction we also like to give two technical comments. Firstly this book is prepared for an international market and a limited number of people know Polish geography. Therefore we present below a map showing local names and regions mentioned in this book. Secondly, we believe that some papers may be interesting not only for those working with White Storks but with other bird species as well, and it would be useful to provide specific abbreviations used frequently in White Stork studies. In papers throughout the book focused on population size and reproductive efforts, abbreviations used during the International White Stork Censuses are used. Below we briefly explain commonly used abbreviations (for more detail and discussion with the system see Schüz 1952):

- H – number of nests,
- HPa – number of nests occupied by a pair longer than one month between 14 April and 15 June,
- HPm – number of pairs with fledging young,
- HPo – number of pairs occupying a nest but without fledging young,
- JZG – total number of young fledged in a local population in a given year,
- JZa – mean number of young fledged per HPa nest,
- JZm – mean number of young fledged per nest (HPm) with breeding success,
- StD – density of HPa nests per 100 km^2.

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We would like to dedicate this book to our neglected families.

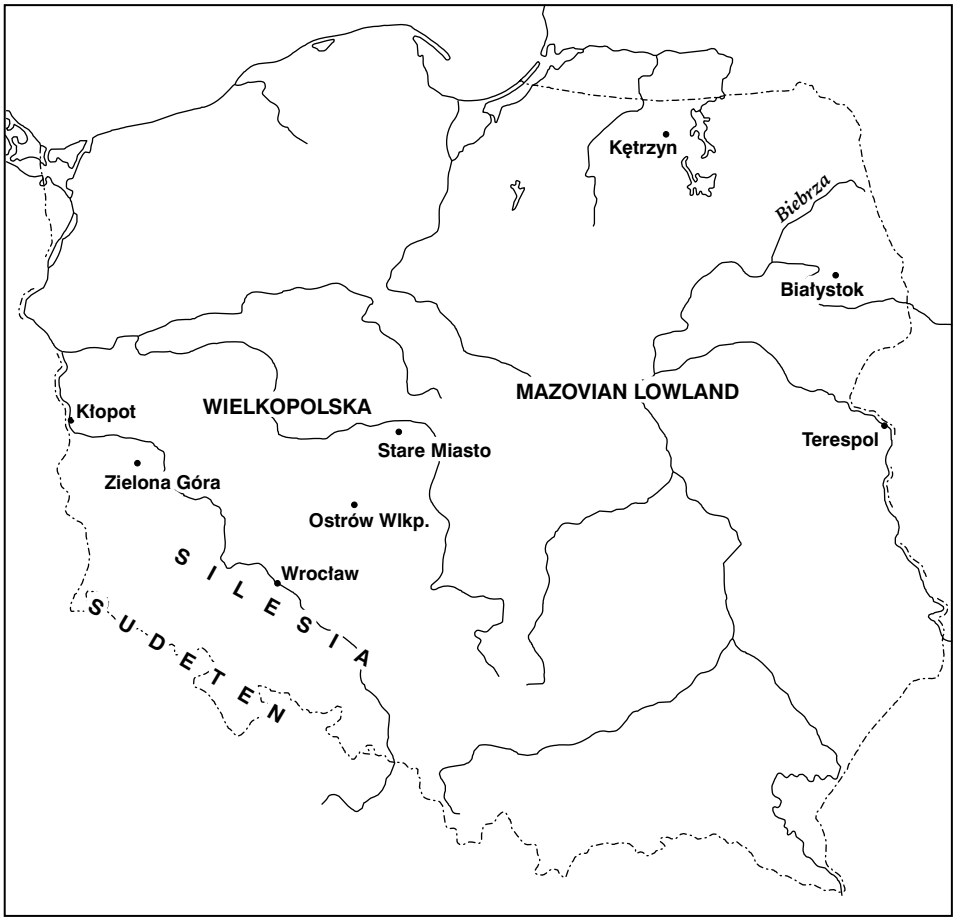

Fig. 1. Study areas mentioned in the book

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