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# Why are white storks delivered to captivity? A case study based on the experience of Polish zoos

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**ABSTRACT:** The aim of the paper was to analyse differences in the number of storks received by zoos in Poland, and investigate factors which influence the year-to-year dynamics of captive storks. We have used data reported in the "Directory of the Zoological Gardens" published from 1984 up to 2004. White storks are delivered to zoological gardens and rehabilitation centres across Poland. The main reason why storks come into captivity are collisions and therefore birds have most frequently injured their wings. The number of storks delivered to zoological gardens and rehabilitation centres increased significantly during the investigated years.

**KEY WORDS**: *Ciconia ciconia,* captivity, zoo, collision, rehabilitation.

## Introduction

The survival of animals, especially birds, which have been injured often depends on the goodwill of people. These animals often end up in zoos or other rehabilitation centres. Among such birds, a large group consists of the white stork *Ciconia ciconia*, probably because of their size and their close association with humans. Birds with only minor injuries usually return to the wild after a few days, However, some stay at the zoo for longer periods, even up to the following spring. In contrast, seriously injured birds, which cannot survive in the wild, spend the rest of their lives in captivity.

Information about these storks (and about other animals kept in Polish zoos) have been collected and published in the Directory of the Polish Zoological Gardens by Miejski Ogród Zoologiczny at Łódź (Lodz Zoo) since 1967.

To start off with, only the number of animals present at the end of each year was published, and these data are not useful for the present analysis. However, since 1984 additional columns have shown: status of the collection on the 1st January, arrivals, other acquisitions, and deaths. Moreover, from the beginning of the 1990s zoos started to use a computer program for collecting data (ISIS – computer-based information system for wild animal species held in captivity) but even now not all zoos participate in this. Using these data we decided to examine what factors influence the number of white storks received by Polish zoos.

The aim of this paper is to analyse differences in the number of storks received by zoos in Poland, and investigate factors which influence the year-to-year dynamics of captive storks.

## Materials and methods

In our investigation we have used data reported in the "Directory of the Zoological Gardens" published from 1984 up to 2004 (Anon, 1988–1998; Kozłowski et al. 1986,1987; Topola 1999–2005). Because every year zoos receive a lot of storks and usually no zoo transfers storks to another zoo, we presumed that the column "other acquisition" is the number of storks brought to zoos from the wild. We believe that error in this number is less than 2%. "Directory" data comes from the zoos at Bydgoszcz Chorzów, Kraków, Łódź, Opole, Płock, Świerkocin, Toruń, Poznań, Warsaw, Wrocław and Zamość. We have additionally received data from Białystok zoo (*pers comm*. Michał Sasinowski), and the "Bociek" Society (*pers comm*. Ireneusz Kaługa). Thanks to their help we have collected information from all the key locations in Poland. Additionally we have used data from ISIS (Łódź, Poznań and Warsaw)

As an index of breeding white stork numbers during the years 1984–2004 we have used data on the number of breeding pairs and their productivity (fledgling success) presented in Tryjanowski et al. (2005).

All basic statistical analyses were applied according to the recommendations of Zar (1999) and were conducted using the statistical package SPSS/PC+.

## Results

White storks are delivered to zoological gardens and rehabilitation centres across Poland (Fig. 1). The main reason why storks come into captivity are collisions and therefore birds have most frequently injured their wings. Of 35 individuals delivered to Poznań Zoo (and for which the reason was reported), 13 birds had broken wings, 14 were young birds thrown out of the nest (1 birds had strings on its legs), 5 had received electric shocks, and 3 were in poor condition. From storks examined during 2003, 2004 and 2005, 28 birds out of 76 were in the first year of their life. Of 65 injured birds, nearly half (N=32) were able to fly after rehabilitation and were successfully released. Another estimate of the proportion of young birds in captivity was given by I. Kaługa (*pers comm*) from the Bocian society, where 80% were young birds.

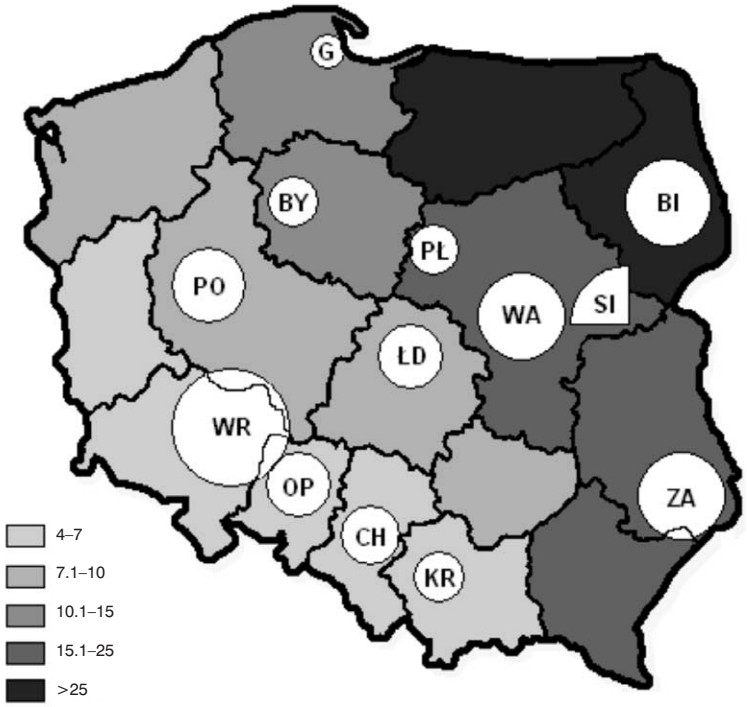


Fig. 1. The number of white storks delivered to zoological gardens during 1984–2004 against the background density/100km$^2$ in 2004
The size of the circle represents the number of delivered storks (for the Bociek society only a segment representing 5 years of their activity 2000–2004 is shown) total N=1992 storks.
Greyscale represents the density of storks/100km$^2$ in each province in 2004 (after: Guziak & Jakubiec 2006). **BI** – Białystok, **BY** – Bydgoszcz, **CH** – Chorzów, **G** – Gdańsk, **KR** – Kraków, **ŁD** – łódź, **OP** – Opole, **PŁ** – Płock, **PO** – Poznań, **SI** – Siedlce (Bociek), **WA** – Warsaw, **WR** – Wrocław, **ZA** – Zamość

The number of storks delivered to zoological gardens and rehabilitation centres increased significantly during the investigated years ($r = 0.800$, $n = 21$, $P < 0.0001$, Fig. 2).

This number was also correlated with the index of the number of breeding pairs in Poland ($r=0.627$, $n=20$, $P=0.003$). The number of breeding pairs increased during the investigated years ($r=0.478$, $n=20$, $P=0.033$). Therefore, to give greater confidence to the validity of this relationship, we also correlated the standardised residuals of storks delivered to zoos on year with the standardised residuals of population size on year, i.e. after eliminating a linear trend. The correlation between the residuals was still significantly positive ($r=0.452$, $p=0.046$), further supporting the relationship between numbers of storks delivered to zoos and population size (Fig. 3).

The number of delivered storks was not correlated with rain in July ($P>0.55$ in all comparisons, included those based on residuals).

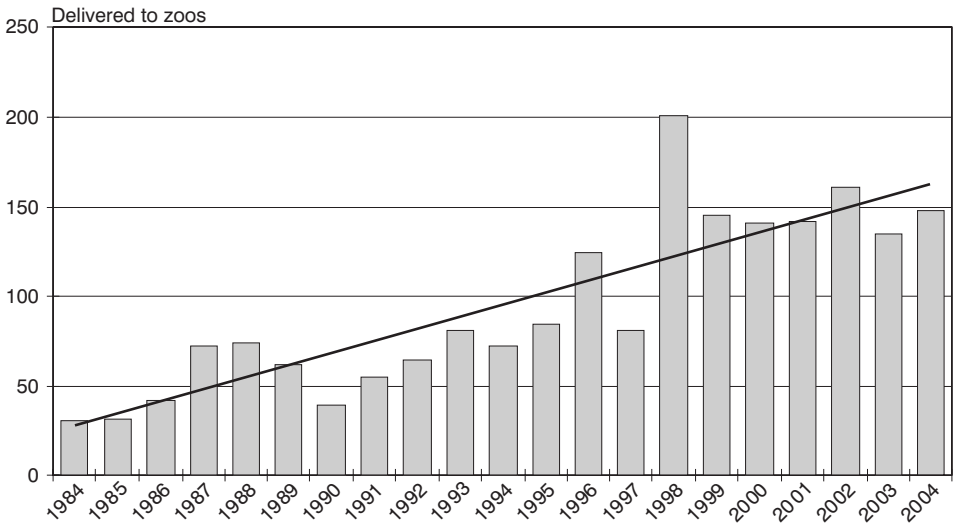


Fig. 2. Number of white storks delivered to Polish zoological gardens during 1984–2004 (N=1992). A linear regression line has been superimposed

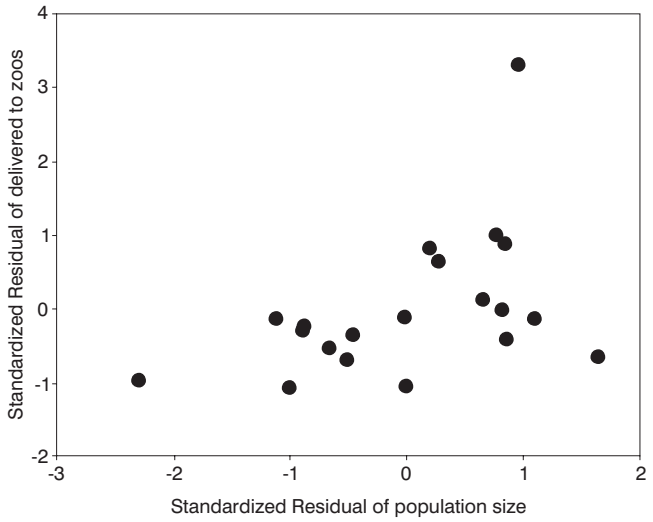


Fig. 3. The relationship between the residuals of number of storks delivered to zoos on year and the residuals of population size on year

## Discussion

The distribution of white storks delivered to zoos does not necessarily reflect the distribution of injured storks in that region. A reason for this is the lack of zoos in eastern and northern Poland (the region with the highest density of storks) and probably a lower number of human inhabitants. On the other hand, the reason for

the biggest number of captive storks at Wrocław was almost certainly Hanna and Antoni Gucwińscy's famous television programme "Among animals with a camera" This program was made at Wrocław zoo.

The number of storks delivered to zoos in 2004 consisted only 0.3% of the wild population in Poland. This small percentage is not important for the survival of the wild population and the effort on rehabilitation might thus be considered to be a waste. However, these storks can support reintroduction programmes in central Europe, and can be an ideal source of birds for such work.

Because the number of delivered white storks was correlated with the number of breeding pairs nesting in each year, this means that zoological gardens can play a monitoring role, not only for white stork but also for other birds species. We can predict population trends according to the dynamic number of delivered birds. Such monitoring should be treated only as an additional measure, but it is very useful and is not expensive. In addition, monitoring at zoos can, in some cases, reveal an increasing population size earlier than investigations carried out in the wild. Such a situation was observed for white tailed sea eagle *Haliaetus albicilla* and Kestrel *Falco tinunculus*.

The white storks were delivered to zoos throughout the year and even during winter, after migration time. These birds were injured during autumn and kept in other places e.g. by a forester, and during winter were delivered to zoos. Some of the birds left zoos by their own choice. Sometimes when a bird can see a group of storks it joins them on migration. Rehabilitation can be an important factor for increasing the number of white storks observed during winter in Poland.

Mostly storks came to zoos during the summer months (July–September, Fig. 4). This reflects the time of fledging (Kosicki et al. 2004) when a large number of young inexperienced storks are delivered to zoos. Only a small proportion of

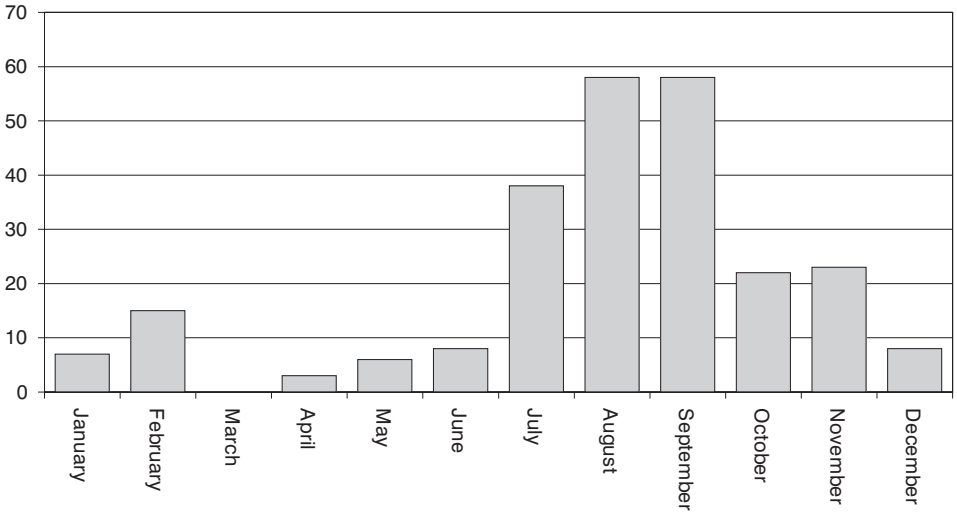


Fig. 4. Number of white storks delivered to Polish zoological gardens in each calendar month. Data from ISIS database for zoos at Łódź, Poznań and Warsaw (N=246)

chicks come to zoos. Probably a lot of chicks die before receiving human help. This may be a reason for the lack of correlation of delivered storks with rainfall in July, usually a key factor in chick survival. On the other hand it is surprising that population dynamics (which influence the number of delivered storks) depends on weather in the Sahel, where storks spend two wintering months (Shaub et al. 2005), or even Sudan and Ethiopia (Sæther et al. 2006). In the same paper we can find information about the influence of climatic conditions during the breeding season, local temperatures during May and June, on population dynamics. Weather may influence the poor condition of birds, which is reflected in the number of delivered birds (Although poor condition was rare reason of delivered storks), and the survival rate during wintering in the Africa. This agrees with Sæther's et al. (2006) idea that summer weather may also affect the gain of body resources among the nonbreeding birds which in turn affects their survival or their probability of obtaining a territory the following spring.

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## References

Anonymous (1988–1998), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych rok 1987, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.

Guziak R., Jakubiec Z. (eds.). 2006. Bocian biały Ciconia ciconia (L.) w Polsce w roku 2004. Wyniki VI Międzynarodowego Spisu Bociana Białego. PTPP „pro Natura". Wrocław.

Kozłowski T., Sosnowska M. Taborski A. Żuchowska E. (1986), The Polish Zoological Gardens – Directory of the Polish Zoological Gardens 1985, The Polish Zoological Society – Section of Zoological Gardens, Łódź.

Kozłowski T., Sosnowska M. Taborski A. Żuchowska E. (1987), The Polish Zoological Gardens – Directory of the Polish Zoological Gardens 1984, The Polish Zoological Society – Section of Zoological Gardens, Łódź.

Kosicki J, Sparks T, Tryjanowski P. 2004. Does arrival date influence autumn departure of the White Stork Ciconia ciconia. Ornis Fennica 81: 91–95.

Sæther B., Grotan V., Tryjanowski P., Barbraud C., Engen S. and Fulin M. (2006), Climate and spatio-temporal variation in the population dynamics of long distance migrant, the white stork. Journal of Animal Ecology 75; 80–90.

Shaub M., Kania W. and Koppens U. (2005). Variation of primary production during winter induces synchrony in survival rates in migratory white storks Ciconia ciconia. Journal of Animal Ecology 74: 656–666.

Topola R.(red./ed.) (1999), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 1998, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.

Topola R.(red./ed.) (2000), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 1999, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.

Topola R.(red./ed.) (2001), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 2000, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.

Topola R.(red./ed.) (2002), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 2001, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.
Topola R.(red./ed.) (2003), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 2002, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.
Topola R.(red./ed.) (2004), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 2003, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.
Topola R.(red./ed.) (2005), Polskie Ogrody Zoologiczne – Informator Ogrodów Zoologicznych 2004, Polskie Towarzystwo Zoologiczne – Sekcja Ogrodów Zoologicznych, Łódź.
Tryjanowski P., Sparks T. H., Jakubiec Z., Jerzak L., Kosicki J.Z., Kuzniak S., Profus P., Ptaszyk J., Wuczynski A. 2005. The relationship between population means and variance in reproductive success differs between local populations of White Stork (Ciconia ciconia). Popul. Ecol. 47: 119–125.
Zar J. H. (1999) Biostatystical analysis. 4th ed. Prentice Hall, New Jersey.