Results of the 6th International White Stork Census 2004/05 for Slovenia

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Zusammenfassung

Während des 6. Internationalen Weißstorchzensus 2004/05 wurde in Slowenien ein nationaler Zensus nach der standardisierten Methodik durchgeführt. Die Verbreitung des Weißstorchs in Slowenien konzentriert sich in den nordöstlichen und südwestlichen Landesteilen. Verglichen mit den Ergebnissen früherer nationaler Erfassungen (1999 – 2003), nahm der Bestand um 18% zu und das Verbreitungsgebiet vergrößerte sich Richtung Nordwesten und Südwesten. Insgesamt wurden 240 bzw. 192 Brutpaare (HPa) den Jahren 2004 und 2005 gezählt. Der Bruterfolg im Jahr 2004 (JZa = 2.23, JZm = 2.59) lag erheblich höher als 2005 (JZa = 1.49, JZm = 2.24). Der niedrigere Brutbestand und der geringere Bruterfolg im Jahr 2005 wurden durch die verspätete Rückkehr der Brutvögel verursacht. Hinzu kamen ungünstige Wetterverhältnisse während der Brutzeit. Die Siedlungsdichte betrug im Jahr 2004 bezogen auf die Gesamtfläche (StD) 1.18 HPa/100 km², bezogen auf die landwirtschaftliche Nutzfläche (StDBiol) = 4.35 HPa/100 km². Er lag 2004 höher als 2005 (StD = 0.94 HPa/100 km², StDBiol = 3.48 HPa/100 km²). Der Internationale Weißstorchzensus ist eine hervorragende Möglichkeit, um die Öffentlichkeit mit Hilfe der Medien für die Natur und den Naturschutz zu begeistern.

Summary

As part of the 6th International White Stork Census 2004/05, a national census was carried out in Slovenia, using standardised census methodology. The White Stork population was concentrated in the north-eastern and south-eastern parts of Slovenia. Compared to results of previous national censuses (1999-2003), numbers in Slovenia increased by 18% and the breeding range had expanded to the north-west and south-west. Totals of 240 and 192 breeding pairs (HPa) were counted in the breeding seasons 2004 and 2005, respectively. Breeding performance in 2004 was substantially better (productivity (JZa) = 2.23, mean fledged brood size (JZm) = 2.59) than in 2005 (JZa = 1.49, JZm = 2.24). The smaller number of breeding pairs and poorer breeding performance in 2005 were caused by the late arrival of White Storks to the breeding grounds, combined with unfavourable weather conditions during the breeding period. Breeding densities (HPa/100 km²) in 2004 (in all habitats (StD) = 1.18, in suitable habitats only (StDBiol) = 4.35) were higher than in 2005 (StD = 0.94, StDBiol = 3.48). The international census provided an excellent opportunity to use the media to influence public attitudes towards nature and nature-conservation in a positive way.

Introduction

The first national White Stork Census in Slovenia was carried out in 1965 (ŠOŠTARIČ 1965). There were repeat surveys in 1979 (JEŽ 1987) and in 1984. In 1984, Slovenia participated in the International White Stork Census (SCHULZ 1999a) for the first time. Since 1999, the national breeding population has been surveyed annually (DENAC 2001), using standardized census methodology and parameters (SCHULZ 1999b). At a regional scale, two censuses have been carried out annually in Slovenia: in north-eastern Slovenia on part of the Drava river lowland, and in south-eastern Slovenia on the Krka river lowland. Both started in 1989 (ŠTUMBERGER 1990, HUDOKLIN 1991) and were integrated into the national census in 1999. In addition, two autecological studies on the White Stork population in Slovenia have been carried out, using census data. The first study explained density-dependent breeding success by means of intraspecific exploitation competition (DENAC 2006a), while the second study established that the effect of weather on the reproduction of the White Stork is resource-dependent (DENAC 2006b). In this report, we present the results of the 6th International White Stork Census, together with results of national censuses since 1999.

Methods

Census methodology during the 6th International White Stork Census was the same as that used in previous annual censuses, which began in 1999 (DENAC 2001). The breeding range of the White Stork was divided into 16 regions, based on a physiographic regionalisation of Slovenia (PERKO 1998). Each region was treated as an independent census unit. In the preparation phase of the census, all surveyors received regional maps, marked with the positions of all known White Storks' nests in their census area, along with nest recording forms. These were produced for each nest, using the central White Stork database for Slovenia. Surveyors were ornithologists from DOPPS-BirdLife Slovenia. Generally, the same surveyors carried out the censuses in the same areas in successive years.

Fieldwork effort was equal in all years. All known nests were visited each year. In addition, areas with no known nests but holding suitable White Stork breeding habitat were regularly and thoroughly searched for new nests. Cars were used for transport, and binoculars to observe breeding parameters. Fieldwork was carried out between 20th June and 15th July in all years, and in 2004/2005 specifically between 28th June and 3rd July, and between 2nd July and 15th July. At each nest, the following breeding parameters were registered: occupancy of the nest (HPa, HPx, HB2, HB1, HO), number of fledged chicks (chicks in the nest during the census were considered as fledged) and the type of nest site. For new nests, the location of the nearest feature, or a GPS fix was recorded. In addition, data on the number of eggs, and the numbers of hatched chicks, ejected chicks and other comments were recorded. Ground and vegetation under the nests were checked for dead chicks. Breeding parameters were obtained by direct observations. These methods were supplemented by interviews carried out by surveyors with local people, to obtain additional data. In addition, in 2004 and 2005, the general public was informed about the International Census, along with a request in a range of media for any information about White Stork nests.

Data were entered in the central White Stork database, and processed. If not obtained with GPS, nest coordinates were derived from a database of house centroids, using the location of the nearest features recorded to nests. Population parameters were analyzed following the recommendations of SCHULZ (1999b). Single birds at nests (HB1) and pairs merely visiting nests (HB2) were combined into a single category, nests occupied by non-breeders (HB). The ratio HB1:HB2 was approximately 1:1 in all years. In calculating productivity (JZa), we excluded pairs with unknown breeding success: JZa = JZG/(HPa – HPx) (MARTÍ 1999), although the number of pairs with unknown breeding success was relatively low. We calculated standard deviations for productivity (JZa) and mean fledged brood size (JZm). We used the surface area of Slovenia (20,370 km^2) to calculate population density (StD), while the extent of potential foraging habitats (5,517 km^2) was used to calculate the biological population density (StDBiol). We selected the following categories from the land use map of Slovenia (MINISTRY OF AGRICULTURE, FORESTRY AND FOOD 2005) as potential feeding habitats: fields and gardens; temporary meadows; permanent meadows and pastures; and wet meadows. Selection of these categories was based on our own observations and current knowledge about the characteristics of White Storks feeding habitats (SACKL 1987, ALONSO *et al.* 1991, PINOWSKI *et al.* 1986, DZIEWIATY 1992, OŻGO & BOGUCKI 1999, MORITZI *et al.* 2001). Population densities (StD and StDBiol) were calculated as the number of pairs (HPa) per 100 km^2 area.

Results

Population size and breeding performance

The population was concentrated in the north-eastern part of Slovenia (Pannonian plains of Mura and Drava rivers and Pannonian hills – Goričko, Slovenske and Dravinjske Gorice), with considerable numbers also in the south-eastern part of the country (Pannonian plain of Krka river and Dinaric plain – Bela Krajina) (Fig. 1). Totals of 240 and 192 breeding pairs (HPa) were counted in the breeding seasons 2004 and 2005, respectively. In 2004, fewer nests occupied by non-breeders (HB = 14) were recorded than in 2005 (HB = 48). Both measurements of breeding density, StD and StDBiol, were higher in 2004 than in 2005 (Tab. 1). Breeding performance in 2004 was substantially higher (productivity (JZa) = 2.23 ± 1.27; mean fledged brood size (JZm) = 2.59 ± 0.97) than in 2005 (productivity (JZa) = 1.49 ± 1.30; mean fledged brood size (JZm) = 2.24 ± 0.93) (Tab. 2).

Population dynamics in time and space

The Slovenian White Stork population has increased over the last 40 years. Between 1965 and 1979, numbers increased by 15% (ŠOŠTARIČ 1965, JEŽ 1987). This was followed by a decline of 18% between 1979 and 1984. From 1984 to 1999, the population increased again, by 47%. From 1999 - 2004 the population size was stable, at around 200 breeding pairs (HPa), but it increased again in 2004, when record numbers of White Storks bred in Slovenia and numbers were 18% higher than in 2003 (Fig. 2).

The increase in population size has been accompanied by an expansion of the species' breeding range. In 1965, the species was found only in one part of the Pannonian region (Pannonian plains of Mura and Drava rivers and Pannonian hills – Slovenske and Dravinjske Gorice) in north-eastern Slovenia. This area can be considered to be the "traditional" breeding range. From 1965 onwards, the breeding range expanded, firstly to the south-east to cover almost the entire Pannonian region (Pannonian plains of Mura, Drava and Krka rivers and Pannonian hills – Goričko, Slovenske and Dravinjske Gorice), as well as to the south-eastern part of the Dinaric plains (Bela Krajina); and secondly to the north-west and south-west, to incorporate the central and south-western part of the Dinaric plains (Ljubljansko barje, Pivško podolje), as well as Alpine plains in the north-western Slovenia (Alpine plains of Sava and Savinja rivers) (Fig. 3). Since 1999, new breeding pairs have colonised positions at higher altitudes (Fig. 4).

Nest locations

There has been a change in nest site selection over the last 40 years. The proportion of nests on chimneys and trees has decreased, while the proportion of nests on various types of power line poles has increased (Fig. 5).

Conservation

The White Stork is one of the species listed on Annex I of the Bird Directive used to identify two IBAs that were later classified as SPAs for this species (BOŽIČ 2003). Approximately 40-44% of the national breeding White Stork population is located within the borders of current SPAs.

Action plans are now needed to ensure that optimal feeding habitats are suitably managed and protected for the White Stork (such as the wet meadows within the most important SPA for the White Stork in Slovenia, Mura (SPA code SI5000010)). These wet meadows support White Stork colonies in Velika and Mala Polana, declared as European White Stork villages in 1999 by Euronatur. As a charismatic umbrella species, White Stork is still under-utilised as a tool to deliver the effective conservation of other endangered species and to assist sustainable regional development in specific parts of Slovenia.

Within the scope of 6th International White Stork Census, several events were organised, focusing on raising public awareness of nature-conservation, and on child and youth education. In 2004, we organised a youth ornithological research camp, which allowed 17 young ornithologists to be involved in the census. 80% of the fieldwork in 2004 was carried out during the research camp, and the results were immediately made public at a presentation that had a wide media response. In addition, we published ten separate articles in the newspapers, gave 15 radio and TV interviews, and made three public lecture presentations of the census results. There was also a special broadcast for the educational programme of the national television channel, that focused on the International White Stork Census.

Discussion

The White Stork population in Slovenia has increased considerably in recent decades. Population growth from 1984 to 1999 corresponds to that found for the world population by the 5th International White Stork Census (SCHULZ 1999a), although the growth of Slovenian population was higher (47%) compared to the global trend for the period 1984 - 1994/95 (23%). Similarly, assuming that the Slovenian population in 1999 was also representative for 1994/95, population growth was higher than in neighbouring countries: Croatia, Hungary, Austria and Italy (SCHULZ 1999a).

A considerable population increase was recorded in 2004. Population growth is generally possible either by immigration or if a population's own breeding productivity outweighs mortality (TOME 2006). As we do not have any data on White Stork mortality, we cannot reliably infer which of the two population processes caused the growth. But, if we assume that the annual adult survival rate is 0.7, and that of young birds until the adulthood is 0.5 (KANYAMIBWA *et al.* 1993), then the productivity rates we observed in the population should exceed mortality, resulting in population growth. This was undoubtedly true for 2000 and 2003, when the proportion of breeding pairs raising young and the total number of fledged young were highest. However, in reality, population dynamics are very complex: survival is weather-dependent (KANYAMIBWA *et al.* 1993), and individuals constantly immigrate and emigrate to and from populations. In addition, we have evidence from ringing recoveries that individuals from France, Croatia, Germany and Switzerland recently bred in Slovenia (Šere, unpublished), which confirms that there is immigration to the Slovenian population.

In 2005, there was a marked decrease in the number of breeding pairs, but the overall population size (including non-breeders) remained approximately the same compared to 2004. In 2005, the arrival of White Storks was delayed on average for about one month. Because of these late arrivals, a significantly higher proportion of storks did not breed and instead behaved as nest visitors.

It seems probable that the White Stork traditional breeding range in north-eastern Slovenia is at carrying capacity, which could explain the expansion of the species' breeding range, including to higher altitudes. Breeding performance is poorest in the traditional breeding range, probably because foraging habitats are less favourable and breeding densities higher. In contrast, breeding performance is best in the recently occupied regions of south-eastern Slovenia, where foraging habitats are better and breeding densities lower. The typical habitat of White Storks in north-eastern Slovenia is composed of large, intensively used fields. In the more-recently occupied parts of the south-east of the country, a larger extent of food-rich meadow habitat is available. Variation in breeding performance between regions is caused by differences in available food resources. Variation in breeding performance between years can be explained by weather, specifically by the amount of rainfall in May, and temperatures in June. Breeding success increases with lower may rainfall and higher June temperatures. However, the weather effect was significant only in the traditional breeding range, which is poorer in terms of food resources. Food was generally a more important reproductive predictor than weather (DENAC 2006b).

In the traditional breeding range, where food resources were poorer, density influenced White Stork breeding success. Solitary pairs and pairs with only one neighbour within their home range most frequently reared three chicks, pairs with two neighbours reared two, but pairs with three or four neighbours generally failed to raise even a single chick. Intraspecific exploitation competition was the reason for density-dependent breeding success (Denac 2006a).

Trends in nest site selection - reductions in numbers of nests on trees and buildings accompanied by an increase in the number of nests on poles - are similar to trends found elsewhere in Europe (GUZIAK & JAKUBIEC 1999, FULÍN 1999, LOVÁSZI 1999). In Slovenia, this has mainly been caused by changes in architecture and by the demolition of traditionally built houses with the huge chimney platforms commonly used by White Storks. In addition, poles are the only suitable place for nests in the areas into which Storks have recently expanded.

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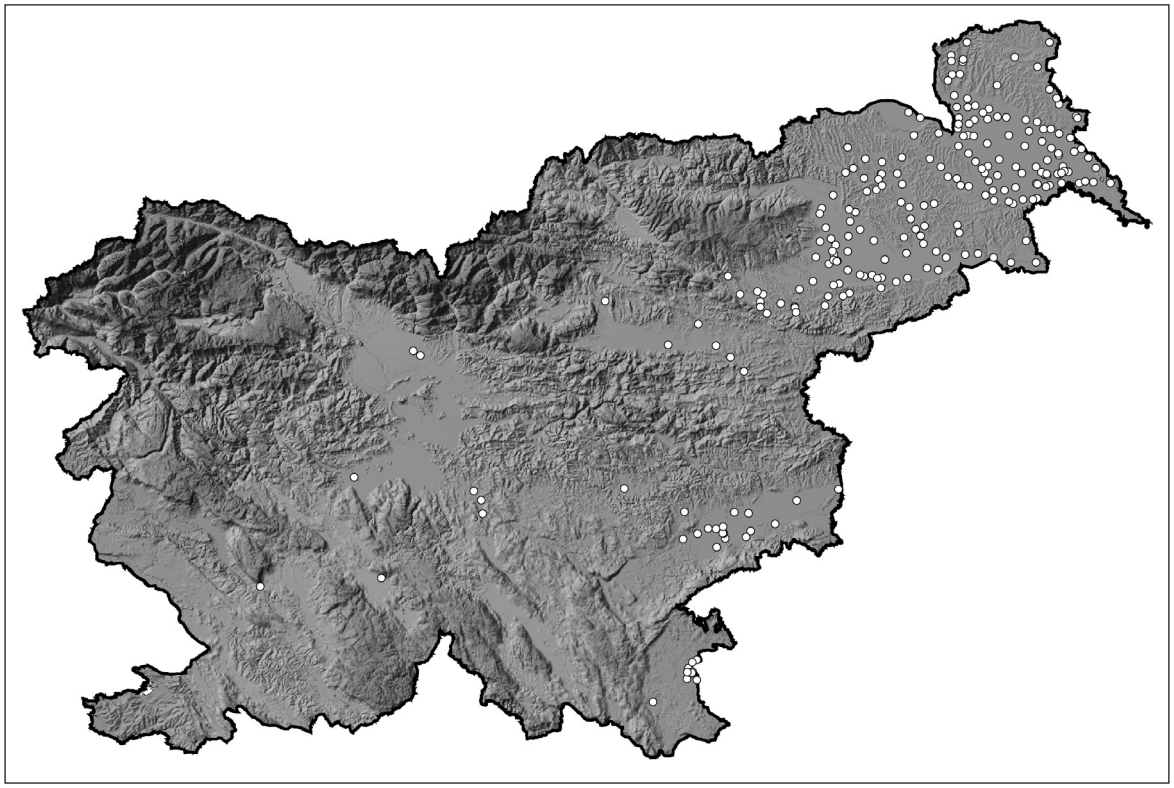

Fig. 1. Distribution of White Stork breeding pairs (HPa) in Slovenia in 2004 (N = 240). Dot = breeding pair (HPa).
Verbreitung des Weißstorchs in Slowenien 2004 (N = 240). Punkt = Brutpaar (HPa).

Tab. 1. White Stork population parameters in Slovenia between 1999 and 2005.

Populationsparameter des Weißstorchs in Slowenien zwischen 1999 und 2005.

Year	HPa	HPm	HPo	%HPo	HPx	HB	StD	StDBiol
1999	203	151	50	24,6	2	19	1,00	3,68
2000	197	168	19	9,6	10	15	0,97	3,57
2001	206	154	44	21,4	8	16	1,01	3,73
2002	199	153	38	19,1	8	21	0,98	3,61
2003	203	162	29	14,3	12	21	1,00	3,68
2004	240	206	33	13,8	1	14	1,18	4,35
2005	192	127	64	33,3	1	48	0,94	3,48

Tab. 2. Breeding performance of the Slovenian White Stork population between 1999 and 2005. Standard deviation is given for the productivity (JZa ± SD) and mean fledged brood size (JZm ± SD).

Bruterfolg der slowenischen Weißstorchpopulation zwischen 1999 und 2005. Die Standartabweichung ist angegeben für den Gesamtbruterfolg (JZa ± SD) und den Teilbruterfolg (JZm ± SD).

Year	JZG	JZa	JZm
1999	363	1,81 ± 1,33	2,40 ± 0,95
2000	451	2,41 ± 1,10	2,68 ± 0,78
2001	397	2,01 ± 1,34	2,58 ± 0,91
2002	417	2,18 ± 1,35	2,73 ± 0,88
2003	458	2,40 ± 1,30	2,83 ± 0,88
2004	534	2,23 ± 1,27	2,59 ± 0,97
2005	284	1,49 ± 1,30	2,24 ± 0,93

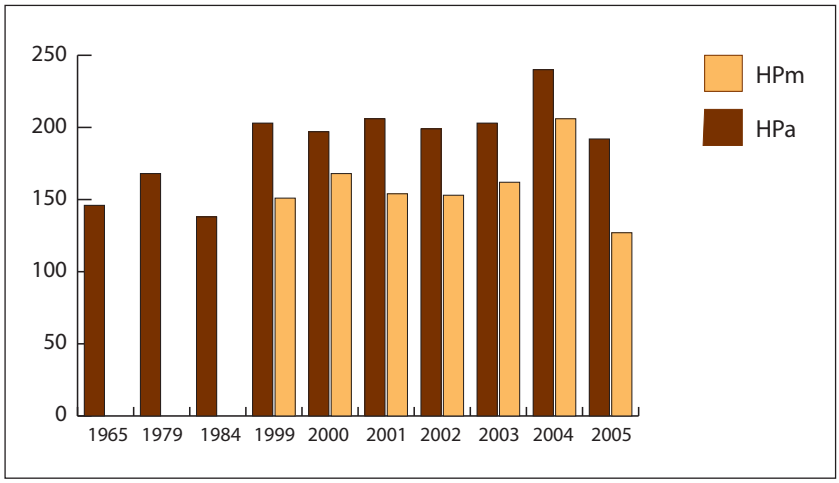

Fig. 2. Population dynamics of White Stork in Slovenia (1965, 1979 and 1984: after ŠOŠTARIČ (1965), JEŽ (1987) and SCHULZ (1999a), respectively).

Bestandsentwicklung des Weißstorchs in Slowenien (1965, 1979 und 1984: nach ŠOŠTARIČ (1965), JEŽ (1987) and SCHULZ (1999a)).

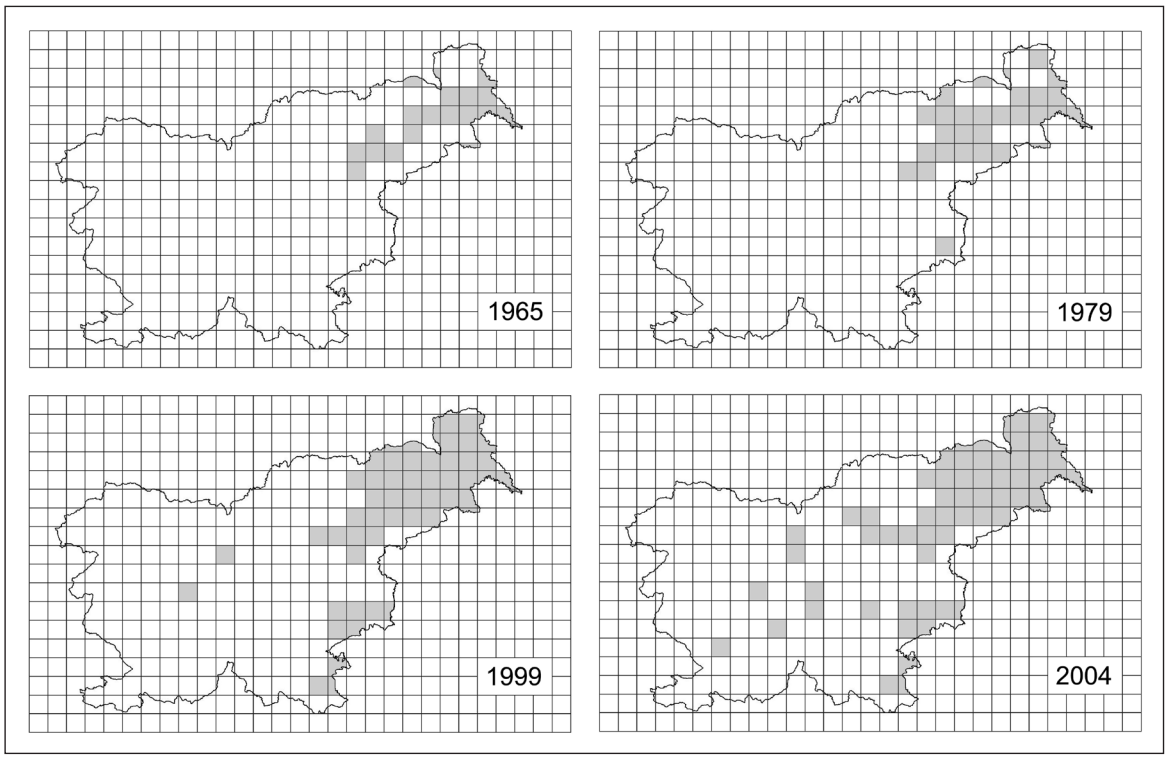

Fig. 3. Expansion of the breeding range of White Stork in Slovenia between 1965 and 2004 (1965 and 1979: after ŠOŠTARIČ (1965) and JEŽ (1987), respectively). Grey cell = minimally one breeding pair (HPa) within the cell's borders. Grid cell = 10×10 km.

Erweiterung der Brutverbreitung des Weißstorchs in Slowenien zwischen 1965 und 2004 (1965 und 1979: nach ŠOŠTARIČ (1965) und JEŽ (1987)). Graue Rasterzelle = mindestens ein Brutpaar (HPa) innerhalb der Zellengrenze. Größe der Rasterzellen = 10×10 km.

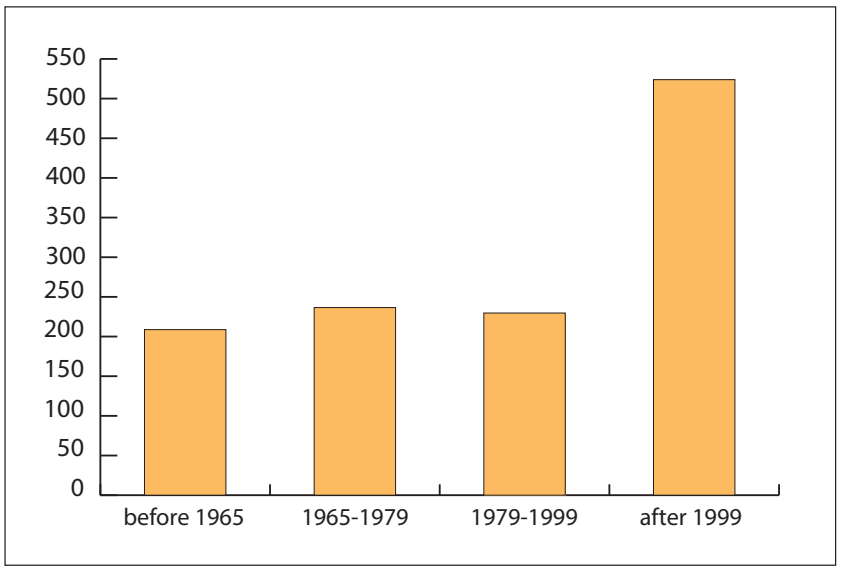

Fig. 4. Average altitudes above sea level of nests of new breeding pairs (HPa) in different time periods. Bars = standard deviation.

Durchschnittliche Höhe über dem Meeresspiegel von neu angesiedelten Weißstorchpaaren in verschiedenen Zeitperioden. Balken = Standartabweichung.

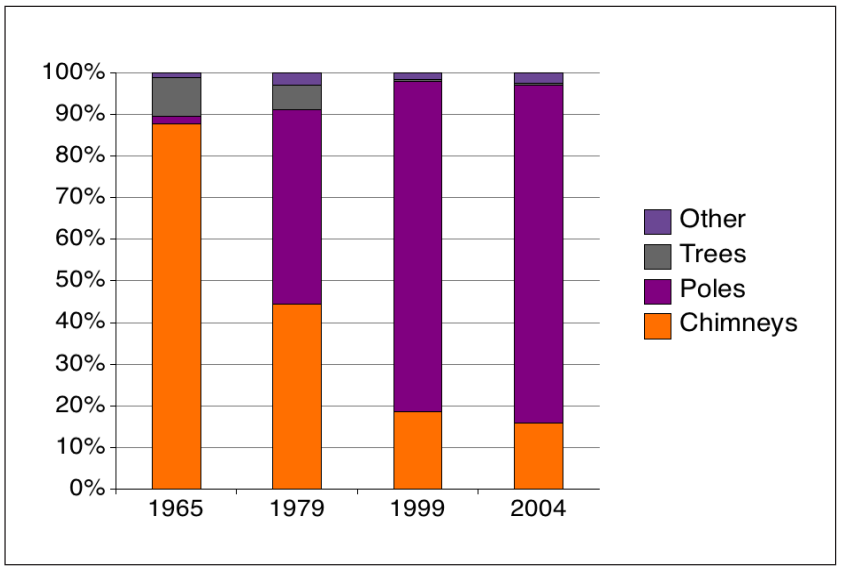

Fig. 5. Nest locations of White Stork in Slovenia (1965 and 1979: after ŠOŠTARIČ (1965) and JEŽ (1987), respectively).

Neststandorte des Weißstorchs in Slowenien (1965 und 1979 nach ŠOŠTARIČ (1965) und JEŽ (1987)).

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