

## POPULATION DYNAMICS OF THE WHITE STORK *Ciconia ciconia* IN SLOVENIA BETWEEN 1999 AND 2010

### Populacijska dinamika bele štokrlje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010

DAMIJAN DENAC

DOPPS - BirdLife Slovenia, P.O. Box: 2990, SI-1001 Ljubljana, Slovenia & National Institute of Biology, Večna pot 111, SI-1000 Ljubljana, Slovenia, e-mail: damijan.denac@dopps.si, damijan.denac@nib.si

Between 1999 and 2010, an annual census of the White Stork *Ciconia ciconia* breeding population was carried out in Slovenia using standardised methods. The Stork's population was concentrated in the NE and SE parts of Slovenia. In the 1999–2010 period, the breeding range of its population in Slovenia expanded in NW direction (the Savska ravan region), in SW direction (the Notranjsko podolje and Pivško podolje regions), but the species also colonized a part between Central and SE Slovenia (Dolenjsko podolje). Between 193 and 240 pairs were breeding during the study period, 209 pairs on average (HPa). The largest number of breeding pairs was recorded in 2004, the smallest in 2005. During the study period, breeding pairs (HPa) occupied 350 discrete nests in total. Average number of breeding pairs that raised juveniles (HPm) was 161. The highest fecundity was recorded in 2004, when 534 juveniles (JZG) fledged, the lowest in 2006, with only 219 fledged juveniles. On average, 414 juveniles fledged per year. The breeding pairs' (JZa) average breeding success in these 12 years was 2.02, the highest in 2000 (2.41), the lowest in 2006 (1.09). Average breeding success for the successful breeding pairs (JZm) was 2.57. The highest was in 2007 (2.94), the lowest in 2006 (2.07). The largest number of breeding pairs in 2004 and 2008 can be explained by the favourable fecundity in the population in 2000 and 2004, as juveniles become sexually mature at the age of 3–5 years, and at that age they generally return to the breeding grounds for the first time. The lowest number of breeding pairs and poor breeding success in 2005 and 2006 was caused by late arrival of White Storks to the breeding grounds and by unfavourable weather conditions during the breeding period. The pattern of nests placement did not change generally during the last 12 years. The largest proportion of nests was positioned on various kinds of poles (81%) and on chimneys (18%). In total, 27 area surveyors and 239 assistants helped in census realisation.

**Key words:** White Stork, *Ciconia ciconia*, breeding population, census, Slovenia

**Ključne besede:** bela štokrlja, *Ciconia ciconia*, gnezditvena populacija, census, Slovenija

#### 1. Introduction

At irregular intervals, the White Stork *Ciconia ciconia* populations have been counted all over the world since 1934. There is no other bird for which statistics on its population trends exist for such a comparably

long period of time. Up till now, six international censuses of the White Stork breeding population have been carried out in the years 1934, 1958, 1974, 1984, 1994/1995 and 2004/2005. The data resulting from these censuses provide an overview of the long term population trend of the White Stork in its overall

breeding range. The dramatic decline of the population registered up until 1984, when it even became extinct in some countries, was followed by a positive population development in the following 20 years. The world population, which in 1984 was ca. 135,000 breeding pairs (HPa), was estimated to be around 166,000 (HPa) in 1994/1995 (SCHULZ 1999A & 1999B). The most prominent increases were noticed for the western population, like Spain, with reasons for the strong increase of the western population mostly attributed to better climatic conditions – less severe droughts – in the wintering areas within western Sahel after the mid-1980s and to development of a wintering population in southern Spain, together with the suite of other factors (TORTOSA *et al.* 1995, SCHULZ 1999B, ZWARTS *et al.* 2009). However, in some SE European countries populations were stable or continued declining (SCHULZ 1999B). For the 6<sup>th</sup> International census 2004/2005, only preliminary results exist, but reveal a further population increase, as the world population was estimated at 230,000 pairs (K.-M. THOMSEN *pers. comm.*).

The first national White Stork census in Slovenia was carried out in 1965 (ŠOŠTARIČ 1965). It was repeated in 1979 (JEŽ 1987) and 1984. In 1984, Slovenia participated in the International White Stork Census (SCHULZ 1999B) for the first time, and for the second time in the 6<sup>th</sup> census 2004/2005. Since 1999, the national breeding population has been surveyed annually (DENAC 2001), using standardized census method and parameters (SCHULZ 1999A, DENAC 2001). On a regional scale, two censuses have been carried out annually in Slovenia: the first in NE Slovenia in part of the Drava river lowland, the second in SE Slovenia in 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 were carried out on the White Stork population in Slovenia using census data. With the first one, we explained density dependent breeding success with intraspecific exploitation competition (DENAC 2006A), whereas the second study showed that weather effect in the reproduction of the White Stork is resource-dependent (DENAC 2006B). In this work we present results of the White Stork censuses carried out between 1999 and 2010.

## 2. Study area and methods

Census method was the same as used during the first annual census in 1999 (DENAC 2001). The White Storks' breeding range was divided into

regions (mesoregions) according to physiographic regionalisation of Slovenia (PERKO 1998). Each region was an independent census unit. In the preparation phase of the census, all surveyors received the regions' maps with marked positions of all known White Storks' nests in their census areas and forms printed for each nest from the central White Stork database for Slovenia. Surveyors were ornithologists and volunteers of DOPPS - BirdLife Slovenia. Generally, the same surveyors carried out the censuses in their corresponding census areas in successive years.

Fieldwork effort was equal in all years. All known nests were visited each year. Besides, villages without nests but with suitable surrounding breeding habitat for the White Stork were thoroughly checked for new nests regularly. Cars were used for transport and binoculars for surveying the breeding parameters. Fieldwork was carried out between 20 Jun and 15 Jul in all years. This is the period just before juvenile White Storks fledge and can be most easily counted from the ground. At each nest, the following breeding parameters were registered: status of the nest or pair (HPa, HPx, HB2, HB1, HO; see Table 1 for explanation) (SCHULZ 1999A), number of fledged chicks (chicks in the nest during the census were considered as fledged), and nest placement. For new nests, address of the nearest building or location obtained by GPS was recorded. Ground and vegetation under the nests were checked for dead, thrown out chicks. Breeding parameters were obtained by direct observations. As a supporting method, surveyors used interviews with local people to obtain additional data. Data on the number of eggs, number of hatched chicks, ejected chicks and remarks were recorded. Furthermore, in 2004 and 2005 a wider public was informed about the 6<sup>th</sup> International census and asked through different media to provide us with any data on White Stork nests.

Data were entered in the central White Stork database and processed. If not obtained with GPS, nest coordinates were gained from database of house centroids using addresses of the nests' nearest buildings. Population parameters were analyzed following recommendations by SCHULZ (1999B). Single nest visitors (HB1) and pairs visiting nests (HB2) were joined into a single category, nest visitors (HB). The HB1 : HB2 ratio was approximately 1 : 1 in all years. In the breeding success calculation (JZa), we excluded breeding pairs with unknown breeding success:  $JZa = JZG / (HPa - HPx)$  (SCHULZ 1999A, MARTÍ 1999), despite the fact that the number of pairs with unknown breeding success was relatively low. We calculated standard deviation for the breeding success (JZa and JZm) (SCHULZ 1999A; see Table 2

**Table 1:** The White Stork *Ciconia ciconia* population parameters in Slovenia between 1999 and 2010**Tabela 1:** Populacijski parametri bele štorcklje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010

Year / Leto	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	193	128	64	33.2	1	48	0.95	3.50
2006	201	106	95	47.3	0	51	0.99	3.64
2007	218	177	40	18.3	1	42	1.07	3.95
2008	237	194	43	18.1	0	17	1.16	4.30
2009	204	161	43	21.1	0	31	1.00	3.70
2010	201	172	29	14.4	0	37	0.99	3.64

Abbreviations after SCHULZ (1999A) / Okrajšave po SCHULZU (1999A):

HPa – Pair that occupied a nest for at least 4 weeks during the first half of the breeding season, “breeding pair” / Par, ki je zasedal gnezdo najmanj 4 tedne v prvi polovici gnezditvene sezone, “gnezdeči par” (HPm + HPo + HPx)

HPm – Pair with fledged young / Par s poletnimi mladiči

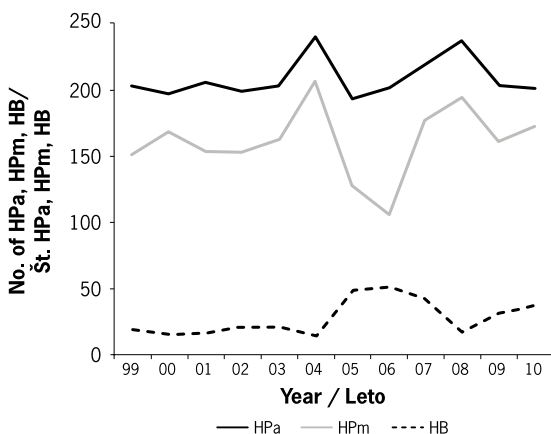
HPo – Pair without fledged young that occupied a nest for at least 4 weeks during the first half of the breeding season / Par brez poletnih mladičev, ki je zasedal gnezdo najmanj 4 tedne v prvi polovici gnezditvene sezone

HPx – Pair with unknown breeding success that occupied a nest for at least 4 weeks during the first half of the breeding season / Par z neznanim gnezditvenim uspehom, ki je zasedal gnezdo najmanj 4 tedne v prvi polovici gnezditvene sezone

HB – Single or two birds (pair) visiting the nest, no ties to the nest / Posamezen osebek ali par obiskuje gnezdo, ni vezi z gnezdom

StD – “Stork density”, population density, No. of pairs (HPa) per 100 km<sup>2</sup> of a defined surface area (i.e. area of the country) / “Gostota štorckelj”, populacijska gostota; št. parov (HPa) na 100 km<sup>2</sup> določene površine (= površina države)

StDBiol – “Biological” population density, No. of pairs (HPa) per 100 km<sup>2</sup> of potential feeding habitat / “Biološka” populacijska gostota; št. parov (HPa) na 100 km<sup>2</sup> potencialnega prehranjevalnega habitata

**Figure 1:** Population dynamics of the White Stork *Ciconia ciconia* in Slovenia between 1999 and 2010**Slika 1:** Populacijska dinamika bele štorcklje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010

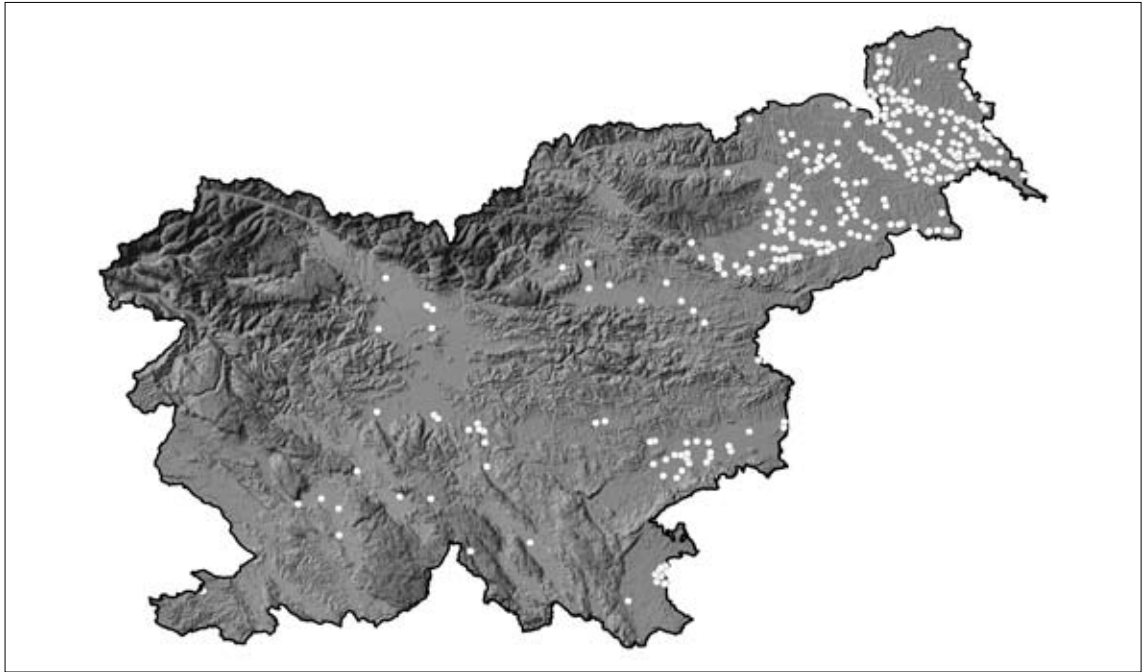
for explanation). We used the surface area of Slovenia (20,272 km<sup>2</sup>) for the calculation of surface-based population density (StD), whereas the surface area

of potential feeding habitats (5,517 km<sup>2</sup>) was used to calculate biological population density (StDBiol). We selected the following land use categories from land use map of Slovenia (MKGP 2005) as potential feeding habitats: fields and gardens (code 1100), temporary meadows (code 1130), permanent meadows and pastures (code 1300) and wet meadows (code 1321). Selection of potential feeding habitats was based on our own observations and current knowledge about the White Stork feeding habitat's characteristics (SACKL 1987, ALONSO *et al.* 1991, PINOWSKI *et al.* 1986, DZIEWIATY 1992, OŽGO & BOGUČKI 1999, MORITZI *et al.* 2001). Population densities (StD and StDBiol) were calculated as the number of breeding pairs (HPa) per 100 km<sup>2</sup> surface.

### 3. Results

#### 3.1. Population distribution and parameters

A total of 193 to 240 breeding pairs (HPa) were counted in the 1999–2010 breeding seasons, ( $\pm$  SD)  $209 \pm 15$  pairs on average. The lowest number of breeding pairs was recorded in 2005 and the highest



**Figure 2:** Distribution of all White Stork *Ciconia ciconia* breeding pairs (HPa) in Slovenia between 1999 and 2010 (N = 350)

**Slika 2:** Razširjenost vseh gnezdečih parov (HPa) bele štoklje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010 (N = 350)

**Table 2:** Breeding success of the Slovenian White Stork *Ciconia ciconia* population between 1999 and 2010 (SD = Standard Deviation)

**Tabela 2:** Gnezditveni uspeh populacije bele štoklje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010 (SD = standardna deviacija)

Year / Leto	JZG	JZa ± SD	JZm ± SD
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	285	1.48 ± 1.30	2.23 ± 0.93
2006	219	1.09 ± 1.23	2.07 ± 0.93
2007	520	2.40 ± 1.42	2.94 ± 0.94
2008	527	2.22 ± 1.34	2.72 ± 0.91
2009	391	1.92 ± 1.35	2.43 ± 1.04
2010	401	2.00 ± 1.15	2.33 ± 0.87

Abbreviations after SCHULZ (1999A) / Okrajšave po SCHULZU (1999A):

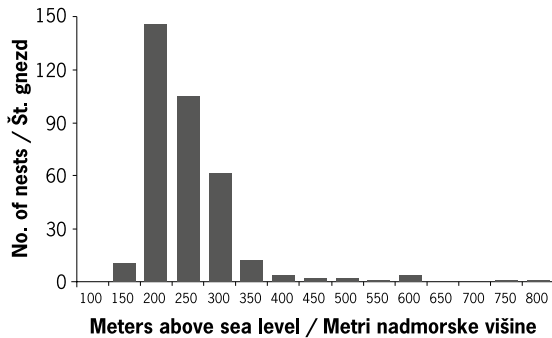
JZG – Total no. of fledged young / Skupno št. poletelih mladičev

JZa – Average no. of fledged young per all breeding pairs / Povprečno št. poletelih mladičev vseh gnezdečih parov (JZG / HPa)

JZm – Average no. of fledged young per all breeding pairs with fledged young / Povprečno št. poletelih mladičev vseh gnezdečih parov s poletelimi mladiči (JZG / HPm)

in 2004 (Table 1, Figure 1, Appendix 1). During the study period, White Stork breeding pairs (HPa) occupied 350 discrete nests in total (Figure 2). On average, ( $\pm$  SD) 161  $\pm$  27 pairs raised juveniles (HPm) in the last 12 years. The largest number of breeding pairs raised their juveniles in 2004, the smallest in 2006. Consequently, the largest number of breeding pairs failed to raise a single juvenile in 2006 (Table 1, Figure 1). The highest fecundity (JZG) was recorded in 2004, when 534 juveniles fledged, the lowest in 2006 with 219 fledged, on average ( $\pm$  SD) 414  $\pm$  95 juveniles fledged per year (Table 2, Appendix 2). Average breeding success ( $\pm$  SD) for breeding pairs (JZa) in 12 years was 2.02  $\pm$  1.35. It was highest in the year 2000 (2.41  $\pm$  1.10), and lowest (1.09  $\pm$  1.23) in 2006 (Table 2, Appendix 3). Average breeding success ( $\pm$  SD) for successful breeding pairs (JZm) in 12 years was 2.57  $\pm$  0.94. It was highest (2.94  $\pm$  0.94) in 2007, and lowest in 2006 (2.07  $\pm$  0.93) (Table 2). Number of nest visitors (HB) was in the 15–59 range. The largest number of nest visitors was recorded in 2005 and 2006, the smallest in 2004 (Table 1, Figure 1).

Population was concentrated in the NE part of Slovenia (the Murska and Dravska ravan regions in the Pannonian plains, and the Slovenske gorice, Dravinjske gorice and Goričko regions in the



**Figure 3:** Altitudinal distribution of all White Stork *Ciconia ciconia* breeding pairs' (HPa) nests in Slovenia between 1999 and 2010 (N = 350) (100 = 0–100 m, 150 = 101–150 m, 200 = 151–200, etc.)

**Slika 3:** Višinska razporeditev gnezd vseh gnezdečih parov (HPa) bele štoklje *Ciconia ciconia* v Sloveniji med letoma 1999 in 2010 (N = 350) (100 = 0–100 m, 150 = 101–150 m, 200 = 151–200 itd.)

Pannonian hills) with considerable numbers in the Pannonian plains in the SE part of Slovenia (the Krška ravan region) and in the Bela krajina and Dolenjsko podolje regions in Dinaric plains (Figure 2, Appendix 1). Smaller disjunct populations were recorded in NW Slovenia in the Savska ravan region, in central Slovenia at Ljubljansko barje, and in SW Slovenia in the Notranjsko podolje and Pivško podolje regions. Altogether, White Storks were recorded to breed in 18 different regions of Slovenia (Appendix 4).

Nests of breeding pairs in 1999–2010 (N = 201) were placed at an average altitude ( $\pm$  SD) of  $226 \pm 77$  m a.s.l. Lowest nest was at 140 m, and highest at 752 m a.s.l. (Figure 3).

### 3.2. Population dynamics in time and space

The size of the Slovenian White Stork breeding population has increased in the last 40 years. A population growth of 15% was recorded in 1979, compared to 1965 (ŠOŠTARIČ 1965, JEŽ 1987). Between 1979 and 1984, the population decreased by 18%. From 1984 to 1999, the population increased again by 47%. In the 1999–2010 period, the population size was generally stable, but with the maximum in 2004, when the highest number of breeding White Storks was recorded so far.

Besides population size increase, the population's breeding range expanded, too. In 1965, it was confined to a part of the Pannonian region (Murska and Dravska ravan, Slovenske and Dravinjske Gorice) in NE only. This part can be considered the bird's

traditional breeding range. From 1965 to 1999, it extended firstly in the SE direction to the almost entire Pannonian region of Slovenia (the Murska, Dravska and Krška ravan regions and the Goričko, Slovenske and Dravinjske Gorice regions) as well as to the Bela krajina region, and secondly in the NW direction to Ljubljansko barje and to the Alpine plains in NW Slovenia (the Savska and Savinjska ravan regions). After 1999, it expanded its breeding range further in the NW (the Savska ravan region) and SW directions (the Notranjsko podolje, Pivško podolje regions), and colonized a part between Central and SE Slovenia (the Dolenjsko podolje region) (Figure 4).

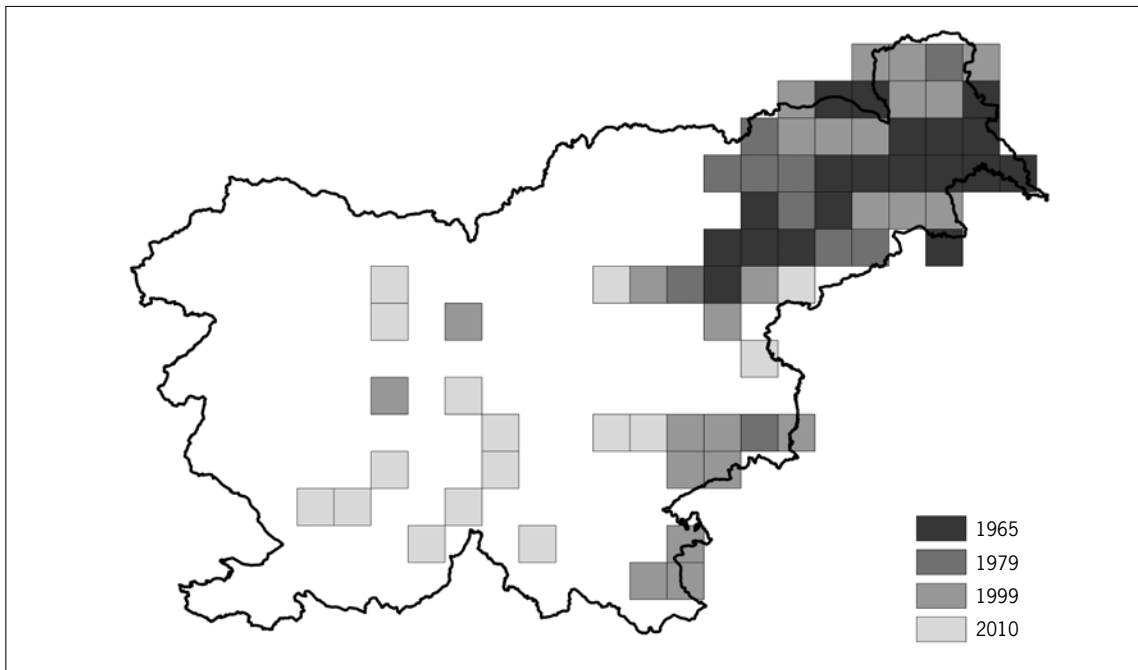
### 3.3. Nest placement

Nest placements changed during the last 40 years. Proportion of nests on chimneys and trees decreased, while the proportion of nests on different power line poles increased (Figure 5). In 2008, the last breeding in a tree was recorded.

## 4. Discussion

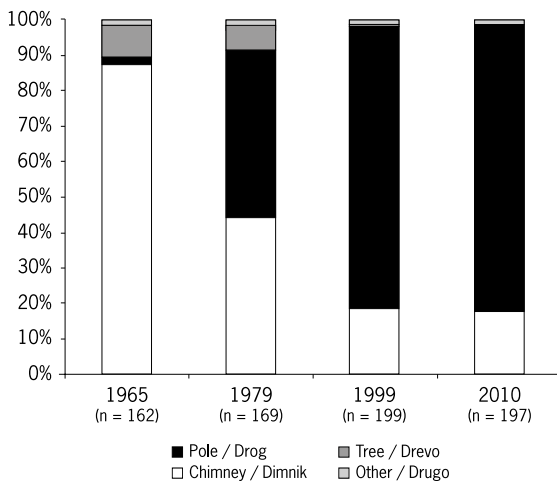
The White Stork population in Slovenia has increased considerably during the last decades. Its population growth from 1984 to 1999 is in agreement with that found for the world population during the 5<sup>th</sup> international White Stork census (SCHULZ 1999B). However, the growth of its Slovenian population was higher (47%) compared to the overall trend for the 1984–1994/1995 period (23%). Similarly, population growth was the highest compared to the neighbouring countries: Croatia, Hungary, Austria and Italy (SCHULZ 1999B), assuming that the Slovenian population in 1999 was representative for 1994/1995.

Between 1999 and 2010, the population was generally stable or slightly increasing but with considerable peaks recorded in years 2004 and 2008. Population growth is generally possible either through immigration or through the population's fecundity, which should be higher than mortality (BEGON *et al.* 2006, TOME 2006). As we do not have any data on the annual mortality of White Storks in the Slovene population, we cannot reliably infer which of the two population processes in fact caused the growth. Assuming that the annual adult survival probability is 0.7, and that the survival of young birds until the adult age is 0.5 (KANYAMIBWA *et al.* 1993), the fecundity of ca. 240 juveniles fledged (JZG) or ca. 1.2 fledged chicks per pair (JZa) would be sufficient to maintain 200 breeding pair population. However, this expert estimate does not account for all the parameters that



**Figure 4:** Expansion of the White Stork's *Ciconia ciconia* breeding range in Slovenia between 1965 and 2010. Distribution in 1965, 1979 and 1999 after ŠOŠTARIČ (1965), JEŽ (1987) and DENAC (2001), respectively. Grey cell = at least one breeding pair (HPa) within the corresponding 10 km UTM square.

**Slika 4:** Širjenje gnezditvenega območja bele štorcklje *Ciconia ciconia* v Sloveniji med letoma 1965 in 2010. Razširjenost v letih 1965, 1979 in 1999 je povzeta po ŠOŠTARIČ (1965), JEŽ (1987) in DENAC (2001). Siva polja = najmanj en gnezdeči par (HPa) znotraj ustreznega 10 km UTM-kvadrata.



**Figure 5:** White Stork's *Ciconia ciconia* nest placements in Slovenia; 1965, 1979 and 1999 data after ŠOŠTARIČ (1965), JEŽ (1987) and DENAC (2001), respectively

**Slika 5:** Mesta gnezd bele štorcklje *Ciconia ciconia* v Sloveniji; podatki za 1965, 1979 in 1999 so povzeti po ŠOŠTARIČ (1965), JEŽ (1987) in DENAC (2001)

should be included in the Population Vulnerability Analysis (PVA). But as the fecundity in 2000 and 2004 was considerably better, and most individuals start breeding 3–5 years old (CRAMP 1977), it is likely that the growth in 2004 and 2008 was caused by particularly good fecundity four years earlier (i.e. in 2000 and 2004). However, in reality open population dynamics is very complex: survival depends on weather (KANYAMIBWA *et al.* 1993) and on primary production at the staging areas in Sahel (SCHAUB *et al.* 2005), and individuals constantly immigrate and emigrate between populations. In addition, from the findings of ringed birds, evidence exists that individuals from France, Croatia, Germany and Switzerland recently bred in Slovenia (unpublished data of the Slovene Museum of Natural History), confirming immigration to the Slovenian population, although to an unknown extent.

In 2005, the number of breeding pairs considerably decreased. In 2005, storks' arrival was delayed for almost one month on average (median 21 Apr 2005 vs. 27–31 Mar 1999 period in DENAC 2001). As a result

of their late arrival, a significantly higher proportion of storks did not breed and behaved like nest visitors. Because of the late start of the breeding, the fecundity in that year was dramatically low too, as there is a clear relationship between the breeding onset and breeding success. Earlier the breeding onset, the higher the breeding success, and the underlying mechanism for the phenomenon is age-dependent breeding success – older birds return in general earlier and are more successful (VERGARA *et al.* 2007) – and condition-related parental quality – heavier females laying more eggs than lighter females (SASVÁRI & HEGYI 2001). The late arrival in 2005 was recorded through the entire breeding range in Europe and was probably caused by severe weather conditions during the spring migration followed by weakened individuals of the breeding population (K.-M. THOMSEN *pers. comm.*). On the contrary, the lowest breeding success recorded during the study, i.e. in 2006, was caused by conditions at the breeding grounds. White Storks returned to the breeding grounds normally. In the second half of May, a week of heavy rains was followed by unusually low temperatures for this period (CEGNAR 2006A & 2006B). Such conditions occurred in the period of greatest susceptibility of juveniles to the outer conditions as they do not develop thermoregulatory ability till the age of ca. 20 days (TORTOSA & CASTRO 2003, JOVANI & TELLA 2004). After this period, we recorded dramatically larger numbers of dead juveniles thrown out of nests than in previous years (84 in 2006 vs. 24–54 in years 1999–2010 without 2006), which is otherwise a normal phenomenon in life-history of the White Stork in such conditions (TORTOSA & REDONDO 1992). Furthermore, in 2006 several heavy hail storms occurred in NE Slovenia, killing a great number of chicks that survived low temperatures in May. Combination of these two weather effects thus caused the lowest breeding success in the study period.

Full carrying capacity of the traditional breeding range in NE Slovenia was probably achieved, which could explain the expansion of the White Stork's breeding range. As a result of less favourable foraging habitats and higher breeding density in the traditional breeding range, the population's breeding success there is the lowest. In contrast, breeding success is the highest in recently occupied regions in SE Slovenia with more favourable foraging habitats and characteristically lower breeding densities. The representative habitat of the White Stork population in the NE part of Slovenia is composed of large, intensively used arable fields. Storks of the SE population have larger areas of food-rich meadows available. Variability of breeding success between the regions is caused by differences

in available food resources. The variability of breeding success between years was explained by weather, specifically by the amount of rainfall in May and temperatures in June. The less the amount of rainfall in May and the higher the temperatures in June, the higher the breeding success. Moreover, weather effect was significant only in the population in the traditional breeding range, which is poorer in the terms of food resources. Food was generally a more important reproductive predictor than weather (DENAC 2006B).

In traditional breeding range with poorer food resources, ecological density influenced the Storks' breeding success. Pairs breeding alone and pairs with one neighbour within their home range most frequently reared three chicks, pairs with two neighbours reared two, whereas pairs with three or four neighbours most frequently failed to raise even a single chick. Intraspecific exploitation competition was the cause for density-dependent breeding success (DENAC 2006A).

The trends in nest site selection – reduction of the number of nests in trees and on buildings and the increase of the number of nests on poles – are similar to the trends found elsewhere in Europe (GUZIAK & JAKUBIEC 1999, FULÍN 1999, LOVÁSZI 1999, RUBACHA & JERZAK 2006, TRYANOWSKI *et al.* 2009). In Slovenia, the trends were mainly caused by changes in architecture and by destruction of traditionally built houses with huge chimneys' platforms commonly used by White Storks. In addition, poles are the only suitable place for nests in the regions where Storks expanded recently.

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## 5. Povzetek

Med letoma 1999 in 2010 smo na območju Slovenije opravili vsakoletni census gnezditvene populacije bele štokrlje *Ciconia ciconia*. Vse cenzone smo izvedli skladno z mednarodno metodo popisovanja. Jedro populacije bele štokrlje je v SV in JV Sloveniji. Od leta 1999 do leta 2010 se je gnezditveno območje bele štokrlje v Sloveniji iz tradicionalnih gnezdišč razširilo v SZ (Savska ravan) in JZ smeri (Notranjsko in Pivško podolje), bela štokrlja pa je kolonizirala tudi del Dolenjskega podolja med osrednjo in JV Slovenijo. V popisnem obdobju je gnezdlilo med 193 in 240 parov (HPa), v povprečju 209. Največje število parov je gnezdlilo leta 2004, najmanjše leta 2005. Skupno so v tem obdobju gnezdeči pari (HPa) zasedli 350 različnih gnezd. Povprečno število uspešnih parov – parov, ki so speljali mladiče (HPm) – je bilo 161. Največjo rodnotost populacije (JZG) smo ugotovili v letu 2004, ko je poletelo 534 mladičev, najmanjšo pa leta 2006, takrat je poletelo 219 mladičev. V povprečju je poletelo 414 mladičev letno. Povprečni gnezditveni uspeh gnezdečih parov (JZa) je bil 2,02, največji je bil leta 2000 (2,41), najmanjši leta 2006 (1,09). Povprečni gnezditveni uspeh uspešnih parov (JZm) je bil 2,57, največji je bil leta 2007 (2,94), najmanjši pa leta 2006 (2,07). Veliko število gnezdečih parov leta 2004 in 2008 lahko razložimo z dobro rodnotostjo v letih 2000 in 2004, saj mladiči spolno dozoriijo med 3–5 leti in se v tej starosti praviloma prvič vrnejo s prezimovališč na območja gnezdenja. Mesta gnezd se v zadnjih 12 letih v glavnem niso spremenila. Največ gnezd (81 %) je bilo na različnih drogovih, večinoma električne napeljave,



sledila so gnezda na dimnikih (18 %). Pri izvedbi cenusa je sodelovalo 27 območnih popisovalcev in 239 pomočnikov oziroma informatorjev.

## 6. References

- ALONSO, J.C., ALONSO, J.A. & CARRASCAL, L.M. (1991): Habitat selection by foraging White Storks, *Ciconia ciconia*, during the breeding period. – Canadian Journal of Zoology 69: 1957–1962.
- BEGON, M., TOWNSEND, C.R. & HARPER, J.L. (2006): Ecology. From Individuals to Ecosystems. – Blackwell Publishing, Oxford.
- CEGNAR, T. (2006A): Podnebne razmere v maju 2006. – Mesečni bilten Agencije RS za okolje 8 (5): 3–20.
- CEGNAR, T. (2006B): Podnebne razmere v juniju 2006. – Mesečni bilten Agencije RS za okolje 8 (6): 3–22.
- CRAMP, S. (ed.) (1977): Handbook of the birds of Europe, the Middle East and North Africa. The birds of the eastern Palearctic. Vol. 1. Ostrich to Ducks. – Oxford University Press, Oxford.
- DENAC, D. (2001): Gnezditvena biologija, fenologija in razširjenost bele štokrlje *Ciconia ciconia* v Sloveniji. – Acrocephalus 22 (106/107): 89–103.
- DENAC, D. (2006A): Intraspecific Exploitation Competition as Cause for Density Dependent Breeding Success in the White Stork. – Waterbirds 29 (3): 391–394.
- DENAC, D. (2006B): Resource-dependent weather effect in the reproduction of the White Stork *Ciconia ciconia*. – Ardea 94 (2): 232–240.
- DZIEWIATY, K. (1992): Nahrungsökologische Untersuchungen am Weißstorch *Ciconia ciconia* in der Dannenberger Elbmarsch (Niedersachsen). – Vogelwelt 113 (3): 133–144.
- FULÍN, M. (1999): The White Stork in Slovakia in 1994 and 1995. pp. 199–202 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- GUZIAK, R. & JAKUBIEC, Z. (1999): Der Weißstorch *Ciconia ciconia* in Polen im Jahr 1995 – Verbreitung, Bestand und Schutzstatus. pp. 171–187 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- HUDOKLIN, A. (1991): Bela štokrlja *Ciconia ciconia* na jugovzhodnem Dolenjskem. – Acrocephalus 12 (47): 24–27.
- JEŽ, M. (1987): Bela štokrlja (*Ciconia ciconia* L.) v Sloveniji v letu 1979. – Varstvo narave 13: 79–92.
- JOVANI, R. & TELLA, J.L. (2004): Age-related environmental sensitivity and weather mediated nestling mortality in white storks *Ciconia ciconia*. – Ecography 27 (5): 611–618.
- KANYAMIBWA, S., BAIRLEIN, F. & SCHIERER, A. (1993): Comparison of survival rates between populations of the White Stork *Ciconia ciconia* in Central Europe. – Ornis Scandinavica 24: 297–302.
- LOVÁSZI, P. (1999): Conservation status of the White Stork in Hungary. pp. 203–211 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- MARTÍ, R. (1999): Results of the 5<sup>th</sup> International White Stork Census (1994) in Spain. pp. 61–68 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- MKG P (2005): Land-use map. – Ministry of Agriculture, Forestry and Food, Ljubljana.
- MORITZI, M., MAUMARY, L., SCHMID, D., STEINER, I., VALLOTTON, L., SPAAR, R. & BIBER, O. (2001): Time budget, habitat use and breeding success of White Storks *Ciconia ciconia* under variable foraging conditions during the breeding season in Switzerland. – Ardea 89 (3): 457–470.
- OŽGO, M. & BOGUČKI, Z. (1999): Home range and intersexual differences in the foraging habitat use of a White Stork (*Ciconia ciconia*) breeding pair. pp. 481–492 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- PERKO, D. (1998): Pokrajine. pp. 120–125 In: FRIDL, J., Kladnik, D., Orožen Adamič, M. & Perko, D. (eds.): Geografski atlas Slovenije: Država v prostoru in času. – DZS, Ljubljana.
- PINOWSKI, J., PINOWSKA, B., DE GRAAF, R. & VISSER, J. (1986): Der Einfluß des Milieus auf die Nahrungseffektivität des Weißstorchs (*Ciconia ciconia* L.). – Beihefte zu den Veröffentlichungen für Naturschutz und Landschaftspflege in Baden-Württemberg 43: 243–252.
- RUBACHA, S. & JERZAK, L. (2006): Changes in the White Stork *Ciconia ciconia* population number, density and breeding places in Zielona Góra region 1926–2004. pp. 47–54 In: TRYANOWSKI, P., SPARKS, T.H. & JERZAK, L. (eds.): The White Stork in Poland: studies in biology, ecology and conservation. – Bogucki Wydawnictwo Naukowe, Poznań.
- SACKL, P. (1987): Über saisonale und regionale Unterscheide in der Ernährung und Nahrungswahl des Weißstorches (*Ciconia c. ciconia*) im Verlauf der Brutperiode. – Egretta 30 (2): 49–79.
- SASVÁRI, L. & HEGYI, Z. (2001): Condition-dependent parental effort and reproductive performance in the White Stork *Ciconia ciconia*. – Ardea 89 (2): 281–291.
- SCHAUB, M., KANIA, W. & KÖPPEN, 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.
- SCHULZ, H. (1999A): The 5<sup>th</sup> International White Stork Census 1994/95 – Preparation, realisation and methods. pp. 39–48 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.

- SCHULZ, H. (1999B): The world population of the White Stork (*Ciconia ciconia*) – Results of the 5<sup>th</sup> International White Stork Census 1994/95. pp. 351–365 In: SCHULZ, H. (ed.): Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 September 1996, Hamburg. – NABU (Naturschutzbund Deutschland), Bonn.
- ŠOŠTARIČ, M. (1965): Štorklje v slovenskem Podravju in Pomurju. – Varstvo narave 4: 81–89.
- ŠTUMBERGER, B. (1990): Popis gnezdišč bele štorklje *Ciconia ciconia* v občini Ptuj v letu 1989. – *Acrocephalus* 11 (43/44): 11–18.
- TOME, D. (2006): Ekologija. Organizmi v prostoru in času. – Tehniška založba Slovenije, Ljubljana.
- TORTOSA, F.S. & CASTRO, F. (2003): Development of thermoregulatory ability during ontogeny in the White Stork *Ciconia ciconia*. – *Ardeola* 50 (1): 39–45.
- TORTOSA, F.S. & REDONDO, T. (1992): Motives for parental infanticide in White Storks *Ciconia ciconia*. – *Ornis Scandinavica* 23 (2): 185–189.
- TORTOSA, F.S., MÁÑEZ, M. & BARCELL, M. (1995): Wintering White Storks (*Ciconia ciconia*) in South West Spain in the years 1991 and 1992. – *Vogelwarte* 38: 41–45.
- TRYANOWSKY, P., KOSICKI, J.Z., KUŹNIAK, S. & SPARKS, T.H. (2009): Long-term changes and breeding success in relation to nesting structures used by the white stork, *Ciconia ciconia*. – *Annales Zoologici Fennici* 46: 34–38.
- VERGARA, P., AGUIRRE, J.I. & FERNÁNDEZ-CRUZ, M. (2007): Arrival date, age and breeding success in white stork *Ciconia ciconia*. – *Journal of Avian Biology* 38: 573–579.
- ZWARTS, L., BIJLSMA, R.G., VAN DER KAMP, J. & WYMENGA, E. (2009): Living on the Edge: Wetlands and Birds in a changing Sahel. – KNNV Publishing, Zeist.

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## APPENDIX 1 / DODATEK 1

Numbers of the breeding White Storks *Ciconia ciconia* (HPa) in Slovenian mesoregions between 1999 and 2010 / Števila gnezdečih parov (HPa) bele štorčije *Ciconia ciconia* po slovenskih mezoregijah med letoma 1999 in 2010

Mesoregion / Mezoregija	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total/ Skupaj	Percentage/ Odstotek (%)
1.3 Savska ravan	I	I	I	2	2	2	3	3	4	4	4	4	31	1.2
1.8 Strojna, Kozjak in Pohorje									I				I	0.0
1.10 Savinjska ravan	3	3	3	4	6	4	I			I	I	3	29	1.2
3.5 Notranjsko podolje						I	I	3	4	4	4	4	21	0.8
3.6 Pivško podolje in Vremšiča	I	I	I	I	I	I	I	2	2	2	I	I	14	0.6
3.7 Ljubljansko barje	I	I	I	I	I	I	I	I	2	3	3	2	18	0.7
3.10 Mala gora, Kočevski rog in Poljanska gora										I			I	0.0
3.11 Velika gora, Stojna in Goteniška gora													I	0.0
3.14 Dolenjsko podolje					2	4	4	4	5	8	8	8	43	1.7
3.16 Bela krajina	5	6	6	6	7	11	10	11	12	15	13	11	113	4.5
4.1 Goričko	11	12	12	12	14	17	11	13	12	12	9	11	146	5.8
4.3 Murska ravan	87	78	83	84	74	82	71	69	75	76	66	62	907	36.3
4.4 Slovenske gorice	29	29	31	29	31	37	25	28	26	30	26	25	346	13.8
4.5 Dravska ravan	36	37	37	31	35	44	36	36	43	41	31	31	438	17.5
4.6 Dravinjske gorice	18	16	18	15	15	17	18	19	17	19	17	15	204	8.2
4.9 Voglajnsko in Zgornjesotelsko gričevje	2	2	2	2	2	2	2	2	2	1	1	2	20	0.8
4.10 Srednjesotelsko gričevje													I	0.2
4.12 Krška ravan	10	11	11	12	13	17	11	9	12	19	19	20	164	6.6
Total / Skupaj	203	197	206	199	203	240	193	201	218	237	204	201	2,502	100.0

Mesoregions after PERKU (1998) / Mezoregije po PERKU (1998)

## II2 APPENDIX 2 / DODATEK 2

Numbers of White Stork's *Ciconia ciconia* fledged juveniles (JZG) in Slovenian mesoregions between 1999 and 2010 / Števila poletnih mladičev (JZG) bele štokrlje *Ciconia ciconia* po mezorogljah Slovenije med letoma 1999 in 2010

Mesoregion / Mezoregija	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total/ Skupaj	Percentage/ Odstotek (%)
1.3 Savska ravan	3			4	3	4	1	10	13	9	8	9	64	1.3
1.8 Strojna, Kozjak in Pohorje									0				0	0.0
1.10 Savinjska ravan	3	3	4	5	5	9	2			0	0	3	34	0.7
3.5 Notranjsko podolje						2	3	7	11	9	11	10	53	1.1
3.6 Pivško podolje in Vremščica		2	2	0	0	2	2	2	6	3	4	0	23	0.5
3.7 Ljubljansko barje	2	3	5	2	3	3	2	4	7	9	8	5	53	1.1
3.10 Mala gora, Kočevski rog in Poljanska gora										2			2	0.0
3.11 Velika gora, Stojna in Goteniška gora												0	0	0.0
3.14 Dolenjsko podolje					4	9	5	10	16	15	24	15	98	2.0
3.16 Bela krajina	10	11	15	15	16	32	23	17	28	35	23	24	249	5.0
4.1 Goričko	19	25	15	26	25	27	17	7	22	24	20	20	247	5.0
4.3 Murska ravan	134	167	167	173	171	182	95	60	186	182	86	124	1,727	34.8
4.4 Slovenske gorice	70	80	56	70	76	86	40	17	63	60	44	52	714	14.4
4.5 Dravska ravan	58	93	68	69	78	91	46	31	89	90	70	51	834	16.8
4.6 Dravinjske gorice	25	28	27	28	34	34	26	23	34	31	39	36	365	7.4
4.9 Voglajnsko in Zgornjesotelsko gričevje	4	5	6	4	3	5		5	7	3	2	6	50	1.0
4.10 Srednjesotelsko gričevje								2	5	0	5	3	15	0.3
4.12 Krška ravan	35	34	32	21	40	48	23	24	33	55	47	43	435	8.8
Total / Skupaj	363	451	397	417	458	534	285	219	520	527	391	401	4,963	100.0

Mesoregions after PERKO (1998) / Mezoregije po PERKU (1998)

## APPENDIX 3 / DODATEK 3

Breeding success of White Storks *Ciconia ciconia* (JZa) in Slovenian mesoregions between 1999 and 2010 / Gnezditveni uspeh (JZa) bele štoklje *Ciconia ciconia* po slovenskih mezoregijah med letoma 1999 in 2010

Mesoregion / Mezoregija	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total/ Skupaj
1.3 Savska ravan	3.00			4.00	1.50	2.00	0.33	3.33	3.25	2.25	2.00	2.25	2.29
1.8 Strojna, Kozjak in Pohorje									0.00				0.00
1.10 Savinjska ravan	1.00	3.00	4.00	1.67	1.00	2.25	2.00			0.00	0.00	1.00	1.48
3.5 Notranjsko podolje				0.00	0.00	2.00	3.00	2.33	2.75	2.25	2.75	2.50	2.52
3.6 Pivško podolje in Vremščica	2.00	2.00	2.00	0.00	0.00	2.00	2.00	1.00	3.00	1.50	4.00	0.00	1.64
3.7 Ljubljansko barje	2.00	3.00	5.00	2.00	3.00	3.00	2.00	4.00	3.50	3.00	2.67	2.50	2.94
3.10 Mala gora, Kočevski rog in Poljanska gora										2.00			2.00
3.11 Velika gora, Stojna in Goteniška gora					4.00	2.25	1.25	2.50	3.20	1.88	3.00	0.00	0.00
3.14 Dolenjsko podolje	2.00	2.20	2.50	2.50	2.67	2.91	2.30	1.55	2.33	2.33	1.77	2.18	2.33
3.16 Bela krajina	1.90	2.78	1.67	2.36	1.92	1.69	1.70	0.54	1.83	2.00	2.22	1.82	2.24
4.1 Goričko	1.54	2.17	2.01	2.08	2.38	2.22	1.34	0.87	2.48	2.39	1.30	2.00	1.83
4.3 Murska ravan	2.41	2.76	1.81	2.59	2.45	2.32	1.60	0.61	2.42	2.00	1.69	2.08	1.91
4.4 Slovenske gorice	1.61	2.51	1.84	2.23	2.36	2.07	1.28	0.86	2.12	2.20	2.26	1.65	2.08
4.5 Dravska ravan	1.47	2.00	1.69	2.15	2.83	2.00	1.44	1.21	2.00	1.63	2.29	2.40	1.92
4.6 Dravinjske gorice	2.00	2.50	3.00	2.00	3.00	2.50		2.50	3.50	3.00	2.00	3.00	1.88
4.9 Voglajnsko in Zgornjesotelsko gričevje								2.00	5.00	0.00	5.00	3.00	2.63
4.10 Srednjesotelsko gričevje	3.50	3.09	2.91	1.75	3.08	2.82	2.09	2.67	2.75	2.89	2.47	2.15	3.00
4.12 Krška ravan	1.81	2.41	2.01	2.18	2.40	2.23	1.48	1.09	2.40	2.22	1.92	2.00	2.65
Total / Skupaj													2.02

Mesoregions after PERKO (1998) / Mezoregije po PERKU (1998)

#### APPENDIX 4 / DODATEK 4

Mesoregions in Slovenia where White Stork *Ciconia ciconia* breeding pairs (HPa) were recorded between 1999 and 2010; mesoregions after PERKO (1998). For mesoregions names see Appendices 1, 2 & 3. / Mezoregije Slovenije z gnezdečimi pari (HPa) bele štoklje *Ciconia ciconia* med letoma 1999 in 2010; meje mezoregij po PERKU (1998). Za imena mezoregij glej dodatke 1, 2 in 3.

