

DISTRIBUTION, POPULATION SIZE AND DYNAMICS OF THE WHITE STORK (*CICONIA CICONIA* L.) IN THE HÂRTIBACIU RIVER BASIN (TRANSYLVANIA, ROMANIA)

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ABSTRACT

Based on the results of the censuses carried out in 2004, the total White Stork population of the Hârtibaciu River Basin is 44 HPa, distributed in 34 localities. The mean population density (StD) for the whole area was only 2.81 HPa/100 km². Most common nest sites are electric pylons (48.93%), chimneys (42.55%) and barns (6.38%). The mean JZa and JZm values for the region were 2.95 and 3.61, values which are higher than the estimated JZa and JZm values needed to keep the population stable. In comparison to the last complete survey in 1974, the 2004 survey shows a - 30.16% HPa decrease in the Târnavă River Basin.

ZUSAMMENFASSUNG: Die Verbreitung Populationsgröße und Dynamik des Weißstorchs (*Ciconia ciconia* L.) im Einzugsgebiet des Hârtibaciu/Harbachs (Transylvanien, Rumänien).

Im Jahre 2004 wurden in 34 Ortschaften insgesamt 44 HPa gezählt. Die durchschnittliche Populationsdichte (StD) betrug nur 2.81 HPa/100 km². Heute baut ein großer Prozentsatz der Vögel (48.93%) seine Nester auf Elektromasten, 42.55% und 6.38% brüten weiter auf Schornsteinen und Scheunen. Die Werte für den Gesamtbrüterfolg (JZa=2.95) und Teilbrüterfolg (JZm = 3.61) lagen über 2.0 und 2.5 und sind zum Bestandehalt ausreichend. Für die letzten 30 Jahre (1974 - 2004) ergibt sich ein Rückgang im Zählungsgebiet von - 30.16% HPa.

REZUMAT: Distribuția, mărimea populației și dinamica berzei albe (*Ciconia ciconia* L.) în bazinul râului Hârtibaciu (Transilvania, România).

În urma recensămintelor din 2004, am identificat 44 perechi de berze albe în 34 de localități ale bazinului Hârtibaciu. Densitatea medie a perechilor (StD) a fost de numai 2,81 HPa/100 km². Valorile medii ale parametrilor JZa și JZm au fost mai mari decât 2,0 și 2,5. Între 1974 - 2004, în bazinul Hârtibaciu, numărul perechilor clocitoare a scăzut cu - 30,16%.

INTRODUCTION

During the VIth International White Stork Census (2004 - 2005) data of 4585 nests were obtained from 2083 localities distributed in 40 counties. The total White Stork population in Romania can be estimated to 5000 - 6000 HPa (Kósa, 2007). With the exception of high mountainous regions and forested areas, the White Stork is distributed all over Romania.

The first regional White Stork census in the Hârtibaciu River Basin was conducted in 1974 by G. Folberth (Klemm, 1975a, b). Some scattered data on the numbers of the White Stork in the Târnavă River Basin were published by the following authors: Klemm (1983), Klemm and Salmen (1988), Philippi (2001), Philippi and Popa (1990), Salmen (1980).

In 2004, the White Stork population from the Hârtibaciu River Basin was censused again. The main goal of this study was to evaluate the population size, breeding parameters and population dynamics of the White Stork in the Hârtibaciu River Basin. The second aim was to characterize the nest sites and the habitat selection of White Storks in this region.

Definition of the study area

The Hârtibaciu River Basin occupies the middle part of Romania and is situated mainly within Sibiu County along about 88 river kilometers. The total size of the Hârtibaciu River Basin is 1563.15 km². The geographical range of the area is from 24°12'E to 24°58'E and from 45°43'N to 46°06'N.

METHODS

Between 11 June and 10 July 2004, 38 villages from the Hârtibaciu River basin were surveyed for White Stork nests by the "Milvus Group" members. The population size and breeding success were established by standard methods used during the International Census of White Stork (Schulz, 1999a, b). The following parameters were registered and calculated: HPa - number of pairs occupying a nest, nesting pairs ($H_{pa} = H_{pm} + H_{po} + H_{px}$); Hpm - number of pairs with fledglings; Hpo - number of pairs occupying a nest but without fledgling; Hpx - number of pairs with unknown breeding success; JZG - total number of fledglings in a defined area per year; JZa - breeding success, average number of fledged young per pair related to all HPa of a defined area (JZG/H_{pa}); JZm - breeding success, average number of fledged young per pair related to all Hpm of a defined area (JZG/H_{pm}); Std - "Stork density": number of pairs (HPa) per 100 km² of a defined area.

Brood sizes were estimated from the ground and the number of successful nests used in the analyses was strictly the number of nests with young about to fledge. It was not always clear whether young from these nests did actually fledge. Nest were photographed with a Canon PowerShot A60 and the geographical location of the stork nests were determined with a Garmin 12CX. Data analysis was made with the FileMaker Pro software and the maps were produced with the ArcGIS 3.2 software.

RESULTS AND DISCUSSION

Distribution, population size and density

The distribution of the 47 White Stork nests identified in the study area is presented in the figure 1. The species was identified in 34 localities (Tab. 1). The mean number of nests/localities is 1.2 and the maximal number of nest/localities is 6 nests/locality. No White Stork nests were identified at the following localities (Fig. 1): Ghijeasa de Sus, Hosman, Ilimbav and Zlagna. Only one locality was not visited by us (Ghijeasa de Sus). One nest was destroyed in Marpod - in spring 2004 - by the electricity company.

Based on the results of the censuses carried out in 2004, the total population of the Hârtibaciu River Basin is 44 HPa (Tab. 1).

Using the definition for the Romanian White Stork colonies - villages with minimum five breeding pairs, among which the maximal distance does not exceed one km (Kósa et al., 2002) - we could identify only two White Stork colonies in the Hârtibaciu River Basin: one in Dealu Frumos (5 H) and the second in Nocrich (6 H). About 1.09% of the Romanian White Stork population breeds in the study area.

The mean population density (Std) for the whole area was 2.81 HPa/100 km². It is much lower than the average value for Romania (4.33 HPa/100 km² in 2004 - Kósa, 2007), but is very similar to the low density calculated (1.68 HPa/100 km²) for the neighbouring Târnava Rivers Basin (Kósa et al., 2005).

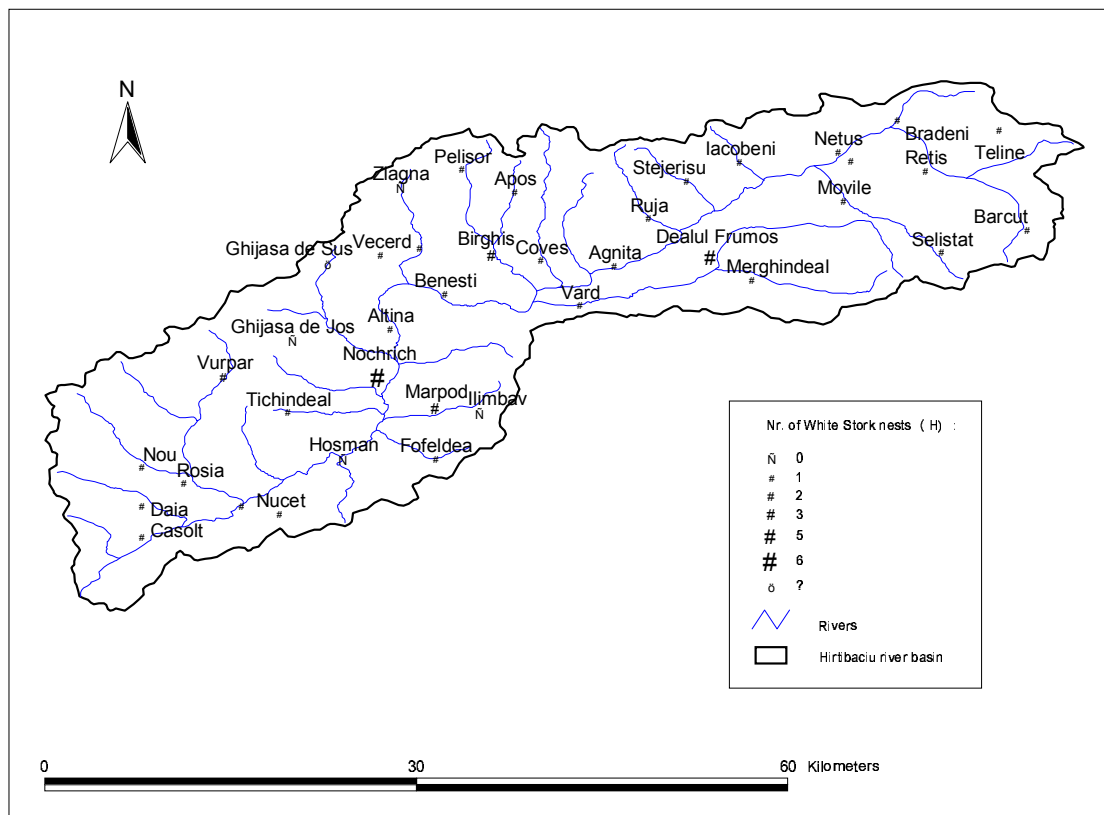


Figure 1: Distribution and number of White Stork nests (H) in the Hârtibaciu River Basin (+ - surveyed localities without White Stork nests, ? - locality not surveyed).

Table 1: List of White Stork nests in the Hârtibaciu River Basin in 2004; Nest support: E - electric pylon, C - chimney, B - barn, CR - church or ruin; Latitude and longitude are expressed in decimal degrees; * - the coordinates represent only the coordinates of the given locality).

Locality	Latitude	Longitude	Altitude (m)	Nest support	HP m	HP o	HP x	uH	JZ G
Agnita	45.97108	24.61637	489	E	1				5
Alțina	45.92975	24.45967	456	CR		1			0
Apoș	46.02717	24.55049	503	E	1				4
Bărcuț	45.99733	24.91953	557	C	1				4
Benești	45.95741	24.49776	433	E	1				2
Bârghiș 1	45.98035	24.53977	464	E				1	0
Bârghiș 2	45.98018	24.53997	457	B	1				4
Bârghiș 3	45.98743	24.53703	474	B	1				4
Brădeni	46.07968	24.82854	474	E	1				5
Cașolt	45.778	24.28232	409	C	1				5
Cornățel	45.80212	24.3571	420	E	1				5
Coveș	45.98911	24.56957	465	E			1		0

Locality	Latitude	Longitude	Altitude (m)	Nest support	HP m	HP o	HP x	uH	JZ G
Daia	45.80205	24.27899	451	C	1				3
Dealul Frumos 1	45.97849	24.6983	470	E			1		0
Dealul Frumos 2	45.98407	24.69555	474	C	1				4
Dealul Frumos 3	45.98445	24.6958	474	C	1				4
Dealul Frumos 4	45.98385	24.69544	474	C				1	0
Dealul Frumos 5	45.98461	24.69604	474	C	1				3
Fofeldea	45.83535	24.49789	469	E		1			0
Iacobeni	46.05018	24.71865	489	E	1				2
Ighişu Vechi	45.98893	24.48377	452	E		1			0
Marpod 1	45.86716	24.46927	430	E		1			0
Marpod 2	45.86966	24.49973	447	E	1				4
Merghindeal	45.96592	24.7246	479	C	1				4
Movile	46.02323	24.79101	503	C	1				4
Netuş	46.05869	24.78733	528	C	1				2
Nocrich 1	45.89638	24.45474	431	C	1				4
Nocrich 2	45.89606	24.45446	432	C	1				4
Nocrich 3	45.89488	24.45451	435	C	1				3
Nocrich 4	45.89362	24.45398	431	C	1				4
Nocrich 5	45.8944	24.45749	430	C	1				2
Nocrich 6	45.89378	24.45321	430	C	1				4
Noiştat	46.05057	24.79987	523	E	1				5
Noul	45.82611	24.28112	479	C	1				2
Nucet*	45.79503	24.3821	492	E	1				4
Pelişor	46.04674	24.51608	496	E	1				3
Retiş	46.04336	24.85103	519	C	1				3
Roşia	45.81396	24.31675	478	C	1				1
Ruja	46.00171	24.67054	490	E		1			0
Seliştat	45.98742	24.85837	556	E	1				4
Stejerişu	46.03815	24.67541	493	E	1				1
Țeline*	46.07447	24.90444	583	B	1				3
Țichindeal	45.86958	24.39004	459	E				1	0
Vărd	45.94688	24.59986	456	C	1				5
Vecerd	45.9837	24.45542	451	E	1				5
Vurpăr 1	45.86479	24.319	454	E		1			0
Vurpăr 2	45.89066	24.33825	464	E	1				5
Total					36	6	2	3	130

Breeding success

To characterize the breeding success we calculated the JZa and JZm values. In 2004, 44 HPa (36 HPm + 2 HPx + 6 HPo) and 130 JZG were recorded. The mean JZa and JZm values for the Hârtibaciu River Basin were 2.95 and 3.61. Thus the mean JZa and JZm values for the region were above 2.0 and 2.5, values which are higher than the estimated JZa and JZm values needed to keep the population stable (Burnhauser, 1983; Lakeberg, 1995). However,

these values have been taken with caution: the last 10 pairs of the White Storks breeding in Switzerland had a breeding success of 2.3 young per pair and this did not halt the decline to extinction by 1950 (Moritzi et al., 2001). The frequency distribution of brood size for the study area in 2004 was as follows (Fig. 2): the percentage of nests with one young (HPm1) was 5.55%, HPm2 - 13.88%, HPm3 - 16.66%, HPm4 - 44.66%, HPm5 - 22.22% (n = 36 HPm).

In 2004 the percentage of breeding failure (%HPo) was low, only 13.63%.

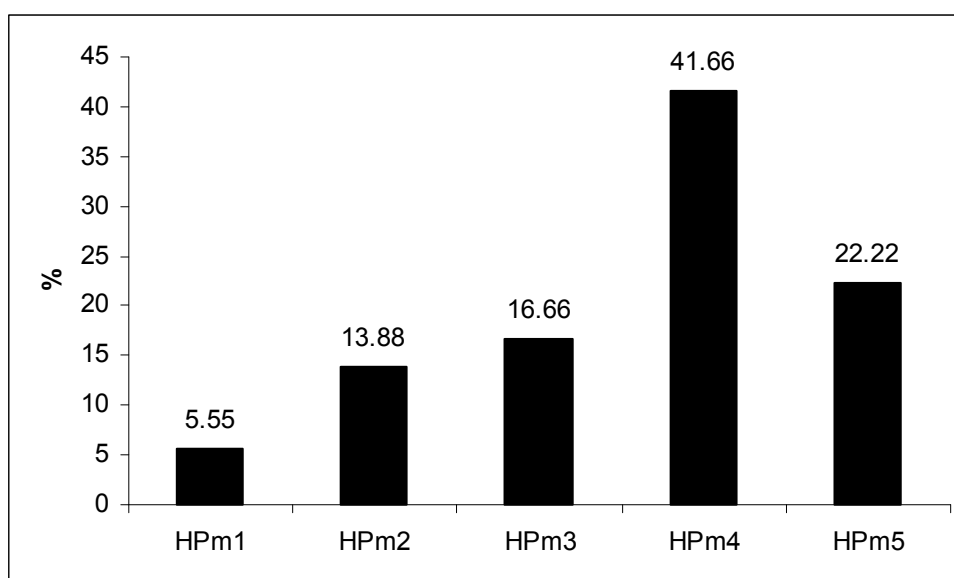


Figure 2: The frequency distribution of brood size in the Hârtibaciu River Basin in 2004 (n = 36 HPm).

Nest site selection

The most common nest sites in the Hârtibaciu River Basin are electric pylons (48.93%), chimneys (42.55%) and barns (6.38%) (Tab. 1 and Fig. 3.). This frequency distribution is similar with that observed in the Târnava Rivers Basin (Kósa et al., 2005). The frequency distribution of nest sites for Romania (2004 - 2005) is the following: 83.9% of nests are constructed on electric pylons and only 12.62% on buildings (chimneys + barns + roofs) (Kósa, 2007). Thus these two river basins remains behind other regions in Romania as far as the proportion of nests constructed on electric pylons is concerned.

During the last decades massive changes have been observed in Romania in nest site preferences, birds moving from buildings to electricity pylons (Kósa, 2001; Kósa et al., 2002). This process has differed significantly in various parts of the country (Kósa et al., 2002). The first White Stork nests placed on electric poles were recorded in Romania in the late 1960s in the Târgu Secuiesc locality (Lemnia) and in Sibiu County in 1988 (Kósa et al., 2002). In this county their number increased from 5 nests in 1988 to 96 nests in 2004 (Philippi and Popa, 1990; Philippi, 2001). Unfortunately, due to the lack of data we do not know when and where this process started in the Hârtibaciu River Basin.

In 1990s, through the national electricity company, the installation of artificial nest platforms on electricity poles was begun in Romania and until 2006 about 1100 poles from 18 counties were equipped with such platforms. Unfortunately no platforms were installed in the Hârtibaciu Basin and here 23 nests are in direct contact with electric wires.

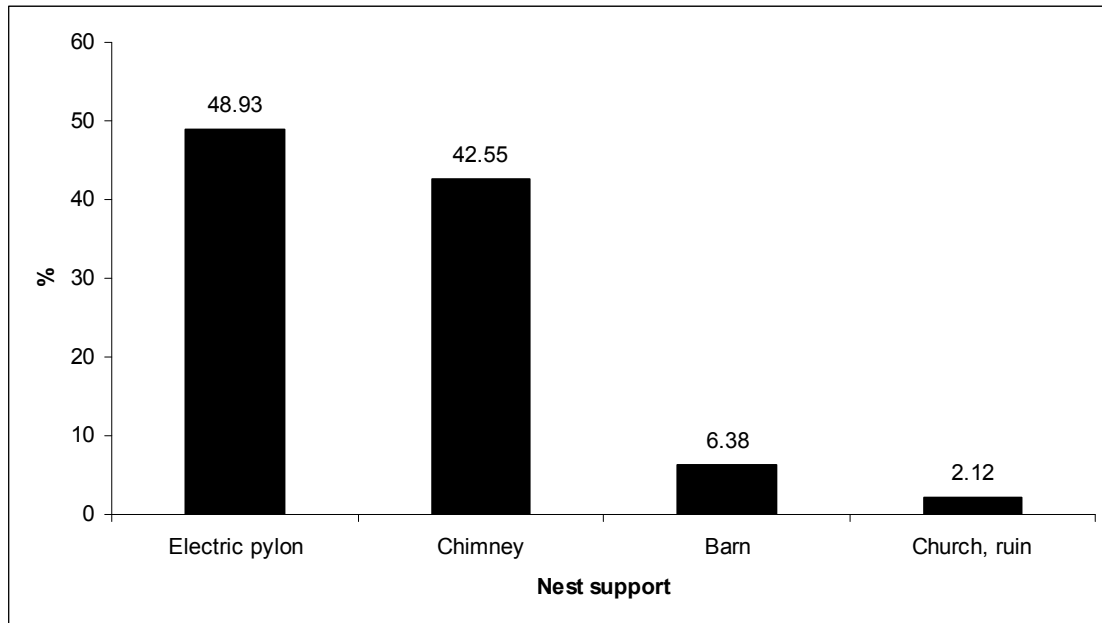


Figure 3: The frequency distribution of White Stork in different nest sites in the Hârtibaciu River Basin (n = 47).

Habitat selection

The availability of high-quality foraging sites close to the nest is one of the factors determining the breeding success of the White Storks. For estimating the general suitability of the environment for the White Stork, a radius of 2.5 km representing the estimated home range of Transylvanian White Storks was drawn around the nests, and these areas were analysed (Fig. 4). Level 2 of Corine Land Cover classes occurring in the buffers were then compared with their occurrence in the Hârtibaciu River Basin.

The table 2 shows observed and expected extension for each category, under the hypothesis of a non-selective use of land types. The distribution of observed values differ significantly from the expected, with a probability of < 0.001 (chi-square test). „Pastures”, and „Arable land” are selected, occurring in the 31% and 25.41% of the area around the nests, against the expected frequencies (29% and 23.13%). Forests are mainly avoided.

Table 2: The observed and expected Corine Land Cover classes occurring within the home range ($r = 2.5$ km) of White Stork nests (for CLC code abbreviations see Fig. 4).

Habitat type	CLC codes	Observed		Expected	
		ha	%	ha	%
Settlement	112, 121	2524.04	2.186	2102.150842	1.821
Arable land	211, 221-222, 242-243	29339.12	25.415	26711.51466	23.139
Pastures	231	35693.59	30.922	33644.803	29.145
Forests	311-313	43031.28	37.277	47627.97326	41.258
Scrub	321,324	3944.57	3.417	4682.220648	4.056
Inland wetlands	411	772.08	0.668	569.11607	0.493
Inland waters	512	125.45	0.108	92.3514921	0.08
Total		115430.13	99.993	115430.13	99.992

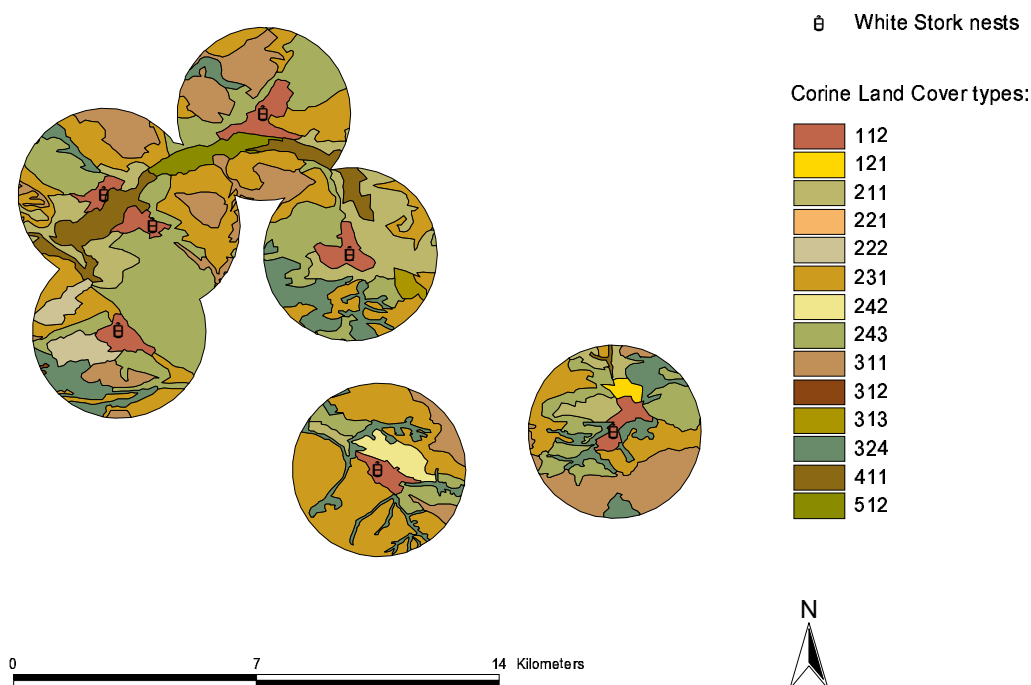


Figure 4: Distribution of Corine Land Cover (Level 2) classes within the home range ($r = 2.5$ km) of seven White Stork nests; 112 - Urban fabric, 121 - Industrial, commercial and transport units, 211 - Arable land, 221 - 222 - permanent crops, 231 - pastures, 242 - 243 - Heterogeneous agricultural areas, 311 - 313 - forest, 324 - scrub, 411 - wetlands, 512 - inland waters).

Population trends

Considering the available amount of White Stork data, the Hârtibaciu Basin is a relative well-studied area in Romania, but the only census covering the whole area was organised in 1974 (Klemm, 1975). Difficulties arise also from the fact that in different years different localities were included in the census. To compare the population trends in a period only those localities were included in the analyses where census data are available in two consecutive censuses.

As we can see in the tables 3 and 4, in comparison to the last survey in 1974, the 2004 census shows a - 30.16% HPa decrease in the Hârtibaciu River Basin. The decrease is smaller than that observed in the Târnava Rivers Basin (Kósa et al., 2005). In 1974 - 2004 the White Stork disappeared from Ghijeasa de Jos, Hosman and Zlagna, but appeared as nesting bird in the following localities: Nucet, Seliștat and Stejerișu.

The Romanian breeding White Stork population underwent a large decline between 1958 and 1978 (Klemm, 1983). Among the causes of the decline, Klemm (1983) listed the disappearance of wetlands due to drainage and river regulation following a systematic government plan and structural changes of the human settlements and attitudes with transition to urban building and behaviour. In the period 1974 - 1989 this decline continued in all the regions of the Olt River Basin from where census data are available (Kósa et al., 2002). For the Hârtibaciu River Basin the HPa decrease was - 34.15% (Tab. 3. and 4.).

Table 3: Population changes (HPa) of the White Stork in the localities of the Hârtibaciu Basin from 1974 to 2004, Klemm (1975 a, b), Philippi, Popa (1990), Philippi (2001).

Locality	1974	1989	1999	2004
Agnita	1		1	1
Alțina	4	1	1	1
Apoș	1	1	1	1
Bărcut	1			1
Benești	2			1
Bârghiș	4	2	2	2
Brădeni	2	1	1	1
Cașolț	1	1	1	1
Cornățel	1	1	0	1
Coveș	2			1
Daia	1	1	1	1
Dealul Frumos	7	4	6	4
Fofeldea	1			1
Ghijeasa de Jos	1			0
Ghijeasa de Sus	1			?
Hosman	1		0	0
Iacobeni	1		1	1
Ighișu Vechi	1			1
Ilimbav	0			0
Marpod	1	1	2	2
Merghindeal	1		1	1
Movile	1	1		1
Netuș	1	1		1
Nocrich	9	4	5	6
Noiștat	2		0	1
Nou	2	1	1	1
Nucet	0	1		1
Pelișor	1			1
Retiș	3		1	1
Roșia	2	2	1	1
Ruja	1			1
Seliștat	0			1
Stejerișu	0	1		1
Țeline			0	1
Țichindeal	1			0
Vărd	2	1	1	1
Vecerd	1	1		1
Vurpăr	1	1	1	2
Zlagna	1	?	0	0
Total	63	27	28	44

Although in 1989 - 1999 and 1999 - 2004 the species experienced moderate increases (9.09 and 10.71%), the population has not recovered to the 1974 level (Tab. 3 and 4). A similar positive trend for this time interval was seen in many regions in Eastern Europe and is generally attributed to the crisis in agriculture during the economic transition period, which resulted in a rapid recovery of biological diversity on agricultural landscapes (Schulz, 1999b).

Table 4: Population dynamics (HPa) of the White Stork in the Hârtibaciu Basin from 1974 to 2004 (n – number of compared localities (Klemm, 1975a, b; Philippi and Popa ,1990; Philippi, 2001).

Year	n	I (HPa)	II (HPa)	%
1974-1989	19	41	27	- 34.15
1989-1999	14	22	24	9.09
1999-2004	21	28	31	10.71
1974-2004	39	63	44	- 30.16

CONCLUSIONS

Based on the results of the census carried out in 2004, the total population of the Hârtibaciu River Basin is 44 HPa distributed in 34 localities. The mean population density (StD) for the whole area was only 2.81 HPa/100 km². The most common nest sites are electric pylons (48.93%), chimneys (42.55%) and barns (6.38%). The mean JZa and JZm values for the region were 2.95 and 3.61, values which are higher than the estimated JZa and JZm values needed to keep the population stable. In comparison to the last survey in 1974, the 2004 census shows a -30.16% HPa decrease in the Hârtibaciu River Basin.

From a conservation point of view it is necessary to continue to monitor the White Stork populations in this region and to begin the installation of artificial nest platforms on electricity poles.

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REFERENCES

1. Burnhauser, A., 1983 – Zur ökologischen Situation des Weißstorchs in Bayern: Brutbestand, Biotopansprüche, Schutz und Möglichkeiten der Bestandserhaltung und -verbesserung. Abschlussbericht, Inst. f. Vogelk., Garm.-Partenk., 1-488.
2. Klemm, W., 1975a – Rezultatele recensămintelor de barză albă (*Ciconia ciconia* L.) în Țara Birsei, Valea Hîrtibaciului și Ținutul Tîrnavelor. *Stud. și Com. Șt. Nat., Muz. Brukenthal* 19:305-309.
3. Klemm, W., 1975b – Recensămîntul berzei albe (*Ciconia ciconia* L.) în împrejurimile Sibiului. *Stud. și Com. Șt. Nat., Muz. Brukenthal* 19:311-318.
4. Klemm, W., 1983 – Zur Lage des Weißstorchs (*Ciconia ciconia*) in der S. R. Rumänien. *Ökol. Vögel* 5: 283-293.
5. Klemm, W., Salmen, H., 1988 – Die Ornis Siebenbürgens. Beiträge zu einer Monographie der Vogelwelt dieses Landes. Böhlau Verlag, Köln-Wien, Vol. III.:17-28.
6. Kósa, F., 2001 – Bestanderfassung des Weißstorchs (*Ciconia ciconia*) in Rumänien im Jahr 1999. In: Kaatz, C. und Kaatz, M. (Eds.) (2001): 2. Jubiläumsband Weißstorch – 2. Jubilee Edition White Stork, 8. u. 9. Storchentag 1999/2000. Tagungsbandreihe des Storchenhofes Loburg (Statliche Vogelschutzwarte im Landesamt für Umweltschutz Sachsen-Anhalt), 30-34.
7. Kósa, F., 2007 - Distribution, population size and dynamics of the white stork (*Ciconia Ciconia* L.) in Romania in 2004-2005 - *in press*.
8. Kósa, F., Demeter, L., Papp, T., Philippi, F., Lutsch, H.-J., György, K., 2002 – Distribution, population size and dynamics of the White Stork (*Ciconia ciconia* L.) in the Upper and Middle Olt River Basin (Romania), *Tiscia Monograph Series*, 6: 205-234.
9. Kósa, F., Papp, T., Pap, P., 2005 – Distribution, population size and dynamics of the White Stork (*Ciconia ciconia* Linnaeus, 1758) in the Târnava Rivers Basin (Romania), *Transylv. Rev. Syst. Ecol. Res*, 2: 155-165.
10. Lakeberg, H., 1995 – Zur Nahrungsökologie des Weißstorchs *Ciconia ciconia* in Oberschwaben (S-Deutschland): Raum-Zeit-Nutzungsmuster, Nestlingsentwicklung und Territorialverhalten. *Ökologie der Vögel*, 17:1-87.
11. 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.
12. Philippi, F., 2001 – Bestanderfassung des Weißstorchs 1988-2000 im Kreis Hermannstadt (Sibiu - Rumänien). In: Kaatz, C. und Kaatz, M. (Eds.) (2001): 2. Jubiläumsband Weißstorch - 2. Jubilee Edition White Stork, 8. u. 9. Storchentag 1999/2000. Tagungsbandreihe des Storchenhofes Loburg (Statliche Vogelschutzwarte im Landesamt für Umweltschutz Sachsen-Anhalt), 34-40.
13. Philippi, F., Popa, Gh., 1990 – Situația cuibăritului berzelor în anul 1989 în județul Sibiu. *Bul. de inf. S.O.R.* (3).
14. Salmen, H., 1980 – Die Ornis Siebenbürgens. Beiträge zu einer Monographie der Vogelwelt dieses Landes. Böhlau Verlag, Köln-Wien, Vol. I.:133-148.
15. Schulz, H., 1999a – The 5th International White Stork Census 1994/1995 - Preparation, realisation and methods. In: Schulz, H. (ed.) (1999): Weißstorch im Aufwind? - White Stork on the up? - Proceedings Internat. Symp. on the White Stork, Hamburg 1996. - NABU (Naturschutzbund Deutschland e.V.), Bonn: 39-48.
16. Schulz, H., 1999b – The world population of the White Stork (*Ciconia ciconia*) – Results of the 5th International White Stork Census 1994/95. In: Schulz, H. (ed.) (1999): Weißstorch im Aufwind? - White Stork on the up? - Proceedings Internat. Symp. on the White Stork, Hamburg 1996. - NABU (Naturschutzbund Deutschland e.V.), Bonn: 351-365.