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Census and spatial distribution of White Stork *(Ciconia ciconia)* population in Kosovo in 2017 and 2018

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Abstract In this study, during 2017–2018, for the first time in Kosovo, research on the census, distribution and population dynamics of the White Stork was made. 61 new nests were found in the whole country territory and together with 22 known nests, the total population is recorded to 83 nests and 72 breeding pairs. In total, 461 chicks were raised in the successful nests. Breeding success for the country territory during the observation period of all breeding pairs was 3.18, and 3.19 of all breeding pairs that raised chicks. The mean breeding density for the entire country was 0.67 breeding pairs/100 km^2 in 2017 and 0.70 in 2018. For the potential feeding habitats, it was 2.19 (2017) and 2.28 (2018). The densest area, the river basin of Lepenci held 2.48 pairs for 100 km^2. 48.61% of all recorded White Stork nests were located on various poles.

Keywords: Kosovo, White Stork, population, census, spatial distribution

Összefoglalás Koszovó első országos szintű fehérgólya-felmérése 2017–2018-ban zajlott le. A korábban is ismert 22 fészek mellett 61 új fészek került elő. A teljes gólyaállomány 72 költőpár volt, amely összesen 461 fiókát repített ki. A fészkenkénti átlagos fiókaszám az összes költőpárra számítva 3,18, a sikeres párokra számítva 3,19 volt. Az állomány országos denzitása 2017-ben 0,67 pár/100 km^2, 2018-ban 0,70 pár/100 km^2, a potenciális táplálkozóterületekre számítva 2,19 (2017), illetve 2,28 (2018) volt. A legsűrűbb állomány a Lepenci folyó vízgyűjtőterületén él (2,48 pár/100 km^2). A fészkek 48,61%-a különféle oszlopokra épült.

Kulcsszavak: Koszovó, fehér gólya, állománynagyság, cenzus, térbeli eloszlás

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Introduction

Until today, seven International White Stork Censuses (IWC) have been carried out in the years 1934, 1958, 1974, 1984, 1994/1995, 2004/2005 and 2014/2015 (Denac 2010, Kaatz *et al*. 2017). Latest censuses showed that population trends of the White Stork are positive in many parts of its range for the first time in several decades, except for the large area of the states in the southern part of the Balkan Peninsula and Turkey (Schulz 1999).

Kosovo is a relatively small country and distinguished by rich biodiversity. Its geographical position, geological factors, hydrology, and climate are some of the factors

that enabled Kosovo to have rich biological diversity, rich flora, fauna, and vegetation as well as the presence of relict, endemic and other important species (Maxhuni *et al.* 2014). Kosovo represents an interesting area in terms of resident and migratory bird fauna, as it is an important part of a major eastern European migration flyway connecting Europe and the Africa/Asia region (Maxhuni *et al.* 2014). Kosovo's fauna in general and especially bird fauna has not been studied sufficiently. So far in Kosovo 220 bird species are recognized and their number is assumed to be larger than 300 species (Maxhuni *et al.* 2018).

Even though White Stork is a common bird in Kosovo, there are no comprehensive studies of population and migration ecology. The earliest description of a Kosovarian stork nest is found in Marčetić and Andrejević's 1960 book (Ornithofauna of Kosovo). At that time, there were 26 localities recorded with a total number of 108 nests accounting for an annual average of 238 young. The total population were estimated to 450 White Stork individuals, but no information on nest location was recorded. An incomplete survey has been done by Pelle (1999), where only 4 breeding pairs were found. During extensive field research from 2006 to 2014, only 22 active nests have been found within 19 localities in the whole country and the nesting population size was estimated to be only 22 pairs, mentioning that data gathering can be effective only if it is continued by White Stork Census. This activity shows that Kosovo still has not all the information regarding its White Stork population (Maxhuni *et al.* 2014).

Detailed surveys have been carried out during the period 2017–2018, the period foreseen for this research study. The main goal of this study has been the first research in Kosovo on the census, spatial distribution, and population dynamics of the White Stork.

Materials and Methods

Nest detection

In addition to the 22 nests known from previous years (Maxhuni *et al.* 2016), new territories were searched in field surveys conducted throughout the country. Since some stork nests were in difficult or even impossible places to reach, such as electric poles, the number of

Figure 1. Stork nests on the poles: (a) and (b) recorded with a drone camera (© A. Mavriqi)
1. ábra Drónkamerás felvételek oszlopon lévő gólyafészkekről (© A. Mavriqi)

juveniles and adults in those nests was determined by images taken with drones *(Figure 1)*. Areas, where nests are located were marked on the map using GPS.

Phenology

Nest visits took place every 3–5 days, between 1st of March and 30th of April to detect arrivals and from 1st of August to 10th of September to detect White Stork departures. The date of the first arrival (return from migration) was recorded when at least one bird was observed in a nest in the area under investigation. Similarly, the date of departure (migration) was recorded as the last date the stork was observed in the nest.

Phenological data were calculated using the Mann-Whitney U test, which is used to determine whether two independent samples are selected from populations with the same distribution (Mann & Whitney 1947).

Census method

Fieldwork was equal over the whole period of this study, 2017–2018, and the effort on White Stork census has been carried out between June 1st and July 31st in both years of the survey. This is the period just before juvenile White Storks fledge. During this study, which at the same time is the first real White Stork census in Kosovo, the following parameters – majority of them recommended by Schulz (1999) – were recorded and calculated at each nest: uH (unoccupied nest); HPa (adult pairs), including HPo (pairs without young), HPx (pairs with an unknown number of young) and HPm1–5 (pairs with 1–5 young); JZG (number of young); JZa (JZG/Hpa – average number of fledge young related to HPa); JZm (JZG/HPm – the average number of fledged young related to HPm); StD (population density or "stork density" as HPa per 100 km^2) and StDBiol ("Biological" population density = number of HPa per 100 km^2 of potential feeding habitat).

Standard notation has been used for the description of the reproductive parameters of White Storks (Nowakowski 2003). The number of young has been recorded from the ground, preferably from a more elevated observation point, with the help of binoculars or a spotting scope (20–60 × magnification). Ground and vegetation under the nests have been checked for possible dead, thrown-out chicks.

The data calculations, obtained for each region where the stork is located, were made by following population parameters. We have used the surface area of Kosovo (10,887 km^2) for the calculation of surface-based population density (StD). The surface area of potential feeding habitats (non-irrigated arable lands, pastures, lands principally occupied by agriculture with significant areas of natural vegetation, natural grasslands) was used to calculate biological population density (StDBiol) both as the number of breeding pairs (Hpa) per 100 km^2 surface. Area of potential feeding habitats was calculated based on the CORINE Land Cover database (Copernicus Land Monitoring Service 2018).

Results

Phenology

During this research conducted from the early spring until autumn in 2017 and 2018, 83 stork nests were detected in different parts of Kosovo. According to the observations made in these nests, it was registered that the first partner of a pair arrived about 3–5 days earlier than the second partner. There were cases when both partners appeared at the nest simultaneously. The average arrival (return from migration) date of storks was recorded as 21 March in 2017 and 19 March in 2018, the average departure date of adults was recorded as 21 August in 2017 and 19 August in 2018. The first storks in both two years have reached the center of Kosovo, in Prelluzhe locality, in early March (11th, or 71st day of the 2017 year and 8th, or 68th day of the 2018 year), compared to others which arrived mostly between 22 and 26 March. The last arrivals reached the area on April 1 (92nd day of 2017) and April 2 (93rd day of the 2018 year) *(Figure 2)*.

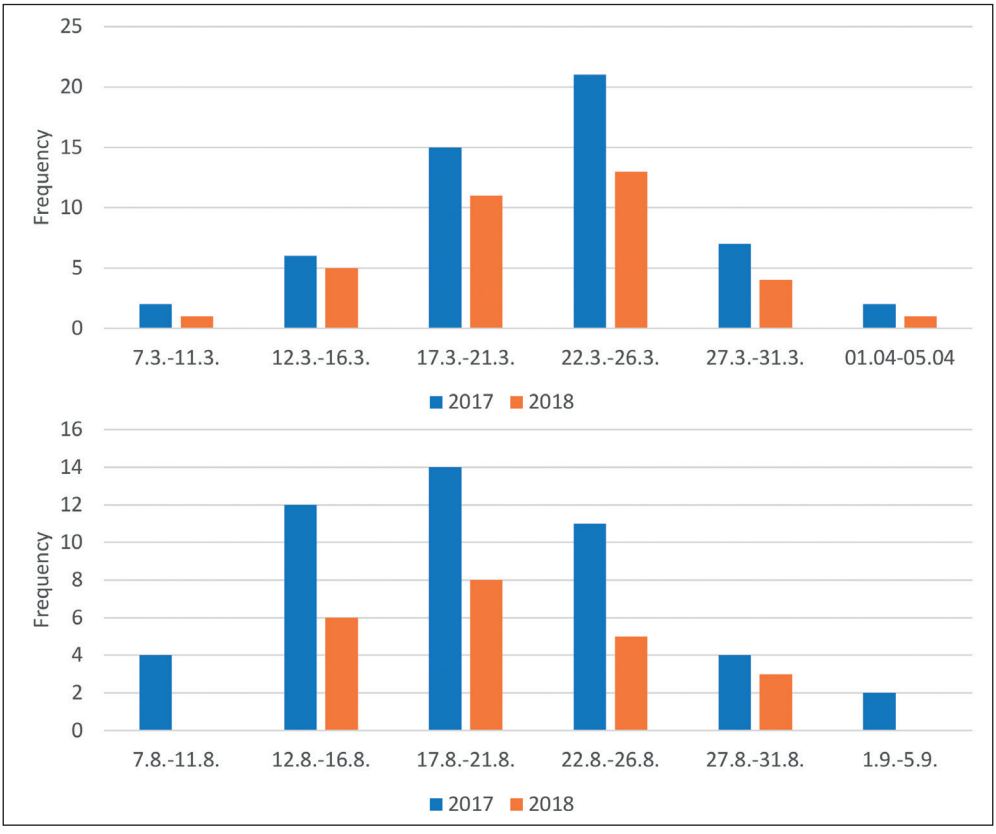

Figure 2. Frequencies of the White Stork arrivals from winter quarters to Kosovo and departures in 2017 and 2018

2. ábra A fehér gólyák tavaszi érkezési és őszi elvonulási időpontjainak megoszlása Koszovóban 2017-ben és 2018-ban

According to our observations, the variability in the arrival date of the second partner did not relate to a considerable extent to the departure date of the individuals from the nest.

Departure dates of adults were also not significantly related to the number of chicks in each nest *(Figure 2)*.

Distribution and population size

The distribution of White Stork nests identified until now in the whole country territory is presented in *Figure 3*. We confirmed the presence of a breeding pair when at least one

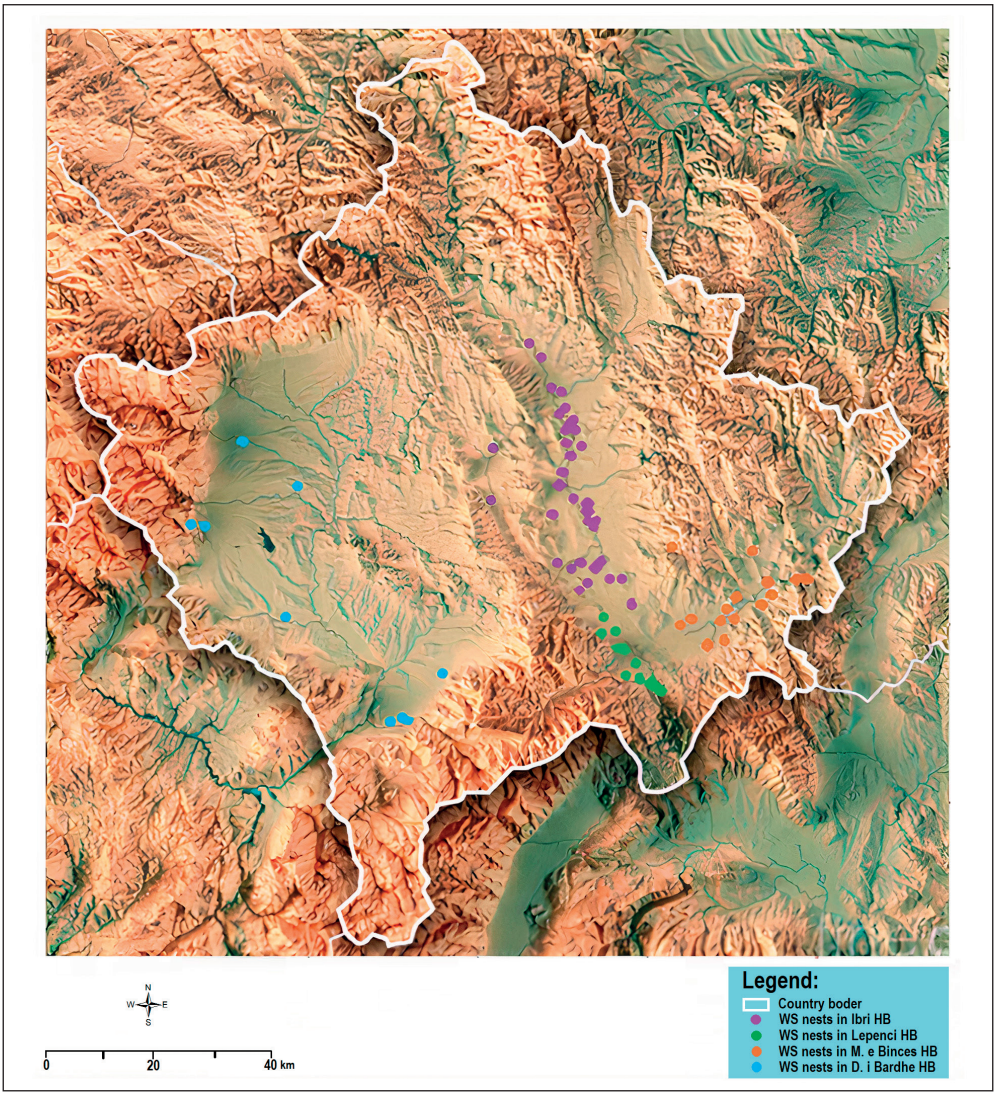

Figure 3. Distribution of White Stork nests (H) in the whole country territory
3. ábra A fehérgólya-fészkek (H) megoszlása az ország területén

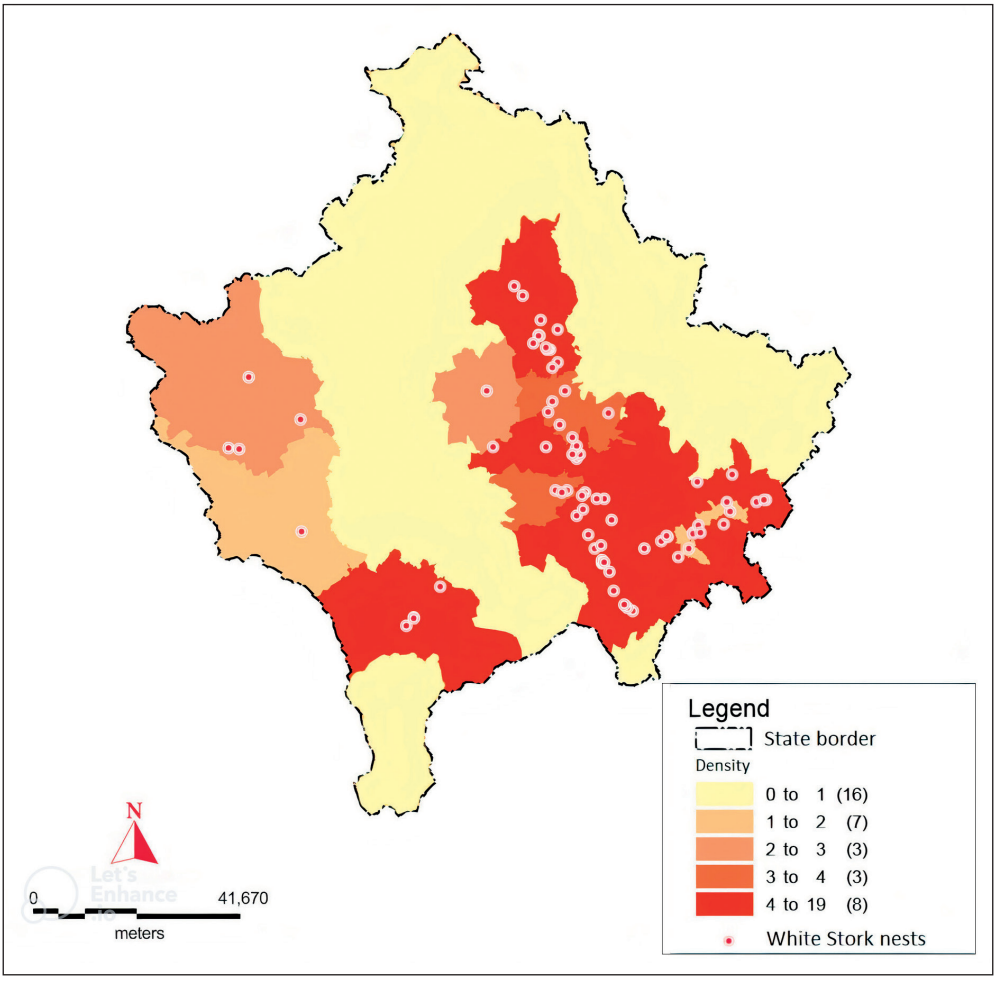

Figure 4. Distribution of densities of occupied White Stork nests
4. táblázat A foglalt fehérgólya-fészkek sűrűség szerinti megoszlása

individual is observed by constructing, defending, incubating, feeding chicks, or perching on the nest and counted the total number of fledglings when they were about 5–7 weeks of age.

During this research 61 new nests were found in the whole country territory and the total population is estimated to be 80 nests in 2017 and 83 nests in 2018 *(Figure 3, 4, Table 1)*. The highest number of nests per village (9) was recorded in Varosh village, the Municipality of Ferizaj *(Figure 7)*.

Nest distribution within hydrographic basins

According to the drainage of river basins, the majority of nests (57 nests) are found in the Black Sea hydrographic basin followed by the Aegean basin (17 nests) and Adriatic basin (9 nests) *(Table 2)*.

Table 1. White Stork cenzus results by localities in Kosovo (2017–2018)
1. táblázat A fehérgólya-felmérés településenkénti eredményei Koszovóban (2017–2018)

Municip.	Locality	H		HE		uH		HPa		HPm		HPo		JZG		JZa		JZm		StD	
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Vushtrri	Vushtrri	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	6.25	6.25
	Nedakovc	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	50.0	50.0
	Lumi i M.	-	1	-	0	-	0	-	1	-	1	-	0	-	2	-	2	-	2	-	50.0
	Prelluzhë	3	3	0	0	0	0	3	3	3	3	0	0	11	10	3.67	3.33	3.67	3.33	42.86	42.86
	Plemetin	4	4	1	0	0	0	3	4	3	4	0	0	10	14	3.33	3.5	3.33	3.5	60.0	80.0
	Bivolak	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Obiliq	Babimoc	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	12.50	12.50
	Obiliq	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	8.33	8.33
	Caravodicë	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	14.29	14.29
Fushë Kosovë	F. Kosovë	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	9.09	9.09
	Vrogoli	1	1	0	0	0	0	1	1	0	1	1	0	0	3	0	3	0	3	33.33	33.33
	Henc	-	1	-	0	-	0	-	1	-	1	-	0	-	4	-	4	-	4	-	50.0
Drenas	Drenas	1	1	0	0	0	0	1	1	1	1	0	0	3	2	3	2	3	2	25.0	25.0
	Nekoc	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	9.09	9.09
Graçanic	Lepi	1	1	0	0	0	0	1	1	1	1	0	0	5	4	5	4	5	4	20.0	20.0
	Suhadoll	1	1	0	1	0	0	1	0	1	0	0	0	3	0	3	0	3	0	14.29	0
Lipjan	Lipjan	5	5	0	0	0	0	5	5	5	5	0	0	17	16	3.4	3.2	3.4	3.2	50.0	50.0
	Topliçan	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	14,29
	Poturoc	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	50.0	50.0

Municip.	Locality	H		HE		uH		HPa		HPm		HPo		JZG		JZa		JZm		StD	
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Shtime	Davidovc	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	50.0	50.0
	Rashincë	1	1	0	0	0	0	1	1	1	1	0	0	3	2	3	2	3	2	16.67	16.67
	Muzeqinë	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	16.67	16.67
Ferizaj	Terrn	2	2	0	0	0	0	2	2	2	2	0	0	5	5	2.5	2.5	2.5	2.5	40.0	40.0
	Prelez i M.	1	1	0	0	0	0	1	1	0	1	1	0	0	0	0	3	0	3	33.3	33.3
	Surçinë	1	1	0	0	0	0	1	1	1	0	0	1	4	0	4	0	4	0	50.0	50.0
	Kosinë	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	14.29	14.29
	Softaj	1	1	0	0	0	0	1	1	1	1	0	0	5	4	5	4	5	4	50.0	50.0
	Lloshkobare	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	16.67	16.67
	Ferizaj	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	9.09	9.09
	Nikadin	1	1	0	0	0	0	1	1	1	1	0	0	2	2	3	2	3	2	25.0	25.0
	Varosh	9	9	0	1	1	1	8	7	8	6	0	1	28	22	3.5	3.14	3.5	3.67	114.3	100.0
Kaçanik	Rakaj	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	33.33	33.33
	Kovaqec	3	3	0	0	0	0	3	3	3	3	0	0	9	8	3	2.67	3	2.67	60.0	60.0
	Tushaj	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	33.33	33.33
	Kaçanik	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	6.25	6.25
Viti	Pozheran	3	3	0	0	1	1	2	2	2	2	0	0	7	7	3.5	3.5	3.5	3.5	20.0	20.0
	Radivojc	2	2	0	0	0	0	2	2	2	2	0	0	6	6	3	3	3	3	50.0	50.0
	Viti	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	11.1	11.11
	Mogillë	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Budrikë e E.	2	2	0	0	1	1	1	1	1	1	0	0	4	4	4	4	4	4	25.0	25.0
	Sadov. e Ç.	1	1	0	0	0	0	1	1	1	1	0	0	3	4	3	4	3	4	14.29	14.29

Municip.	Locality	H		HE		uH		HPa		HPm		HPo		JZG		JZa		JZm		StD	
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Partesh	Partesh	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	12.5	12.5
	Pasjan	1	1	0	0	0	0	1	1	1	1	0	0	3	4	3	4	3	4	6.67	6.67
Gjilan	Lladovë	1	1	0	0	0	0	1	1	1	1	0	0	2	2	2	2	2	2	33.33	33.33
	Velekincë	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	20.0	20.0
	Livoq i E.	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	12.5	12.5
	Shillovë	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	11.11	11.11
	Bresalc	2	3	0	0	0	0	2	3	2	2	0	1	6	6	3	2	3	3	10.53	15.79
Pejë	Pejë	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	4.0	4.0
	Qallopek	1	1	0	0	0	0	1	1	1	1	0	0	5	4	5	4	5	4	25.0	25.0
Deçan	Pobergjë	1	1	0	0	0	0	1	1	1	1	0	0	3	4	3	4	3	4	7.14	7.14
	Drenoc	1	1	0	0	0	0	1	1	1	1	0	0	3	3	3	3	3	3	16.67	16.67
Gjakovë	Gjakovë	1	1	0	0	0	0	1	1	1	1	0	0	4	3	4	3	4	3	4.35	4.35
Prizren	Prizren	4	4	0	0	0	0	4	4	4	4	0	0	14	13	3.5	3.25	3.5	3.25	14.81	14.81
Total:		**80**	**83**	**2**	**2**	**5**	**5**	**73**	**76**	**71**	**72**	**2**	**4**	**237**	**224**	**3.25**	**2.95**	**3.34**	**3.11**	**0.67**	**0.70**

Table 2. White Stork nest distribution on hydrographic basins, municipalities in the years 2017–2018
2. táblázat A fehérgólya-fészek megoszlása közigazgatási egységenként és vízgyűjtő területenként 2017–2018-ban

Flows into	River basin	Rivers	Municipality	No. of localities	No. of nests	Total localities	Total nests	No. of nests/ 100 km²
Black Sea	Ibri	Sitnica	Vushtrri	6	11	28 (51.85%)	38 (45.78%)	0.95
			Ferizaj	6	7			
			F. Kosovë	3	3			
			Lipjan	3	7			
			Shtimje	3	3			
			Graçanicë	2	2			
		Sitnica (2) Llapi (1)	Obiliq	3	3			
		Drenica	Drenas	2	2			
	Morava e Binçes	Morava e Binçes	Viti	6	10	13 (20.07%)	19 (22.89%)	1.21
			Partesh	2	2			
			Gjilan	5	7			
Aegean Sea	Lepenci	Nerodimja	Ferizaj	3	11	7 (12.96%)	17 (20.48%)	2.48
		Lepenci	Kaçanik	4	6			
Adriatic Sea	Drini i Bardhë	Lumbardhi i Pejës	Pejë	2	2	6 (11.11%)	9 (10.84%)	0.19
		Lumbardhi i Deçanit	Deçan	2	2			
		Lumbardhi i Prizrenit	Prizren	1	4			
		Ereniku	Gjakovë	1	1			
		Total:		**54**	**83**			**0.76**

Comparing the data from the three hydrographic basins is possible to see that the Ibri hydrographic basin is the most important. It contains the highest number of identified nests – 38 (45.78%) followed by Morava e Binçes with 19 nests (22.89%), Lepenci 17 nests (20.48%), and the last one Drini i Bardhe with only 9 nests (10.84%) *(Table 2)*.

About 21.69% of the whole breeding population was found only in Ferizaj municipalities. The mean standard density of active White Stork nests per municipality has been found to be significantly changing from one municipality to another and indicated that Ferizaj municipality holds the largest breeding population over the country (18 nests or about 22%). While at the same time, mean standard density of active White Stork nests per river basin indicate that Lepenci River Basin holds the densest breeding population (2.48 pairs/100 km², compared to the value of 0.70 calculated for the entire country).

Population density

During this first national White Stork census, the Kosovarian population was estimated to be 71 breeding pairs in 2017 and 72 in 2018 with a mean breeding density of 0.67 (0.70 in 2018) breeding pairs/100 km² of country territory (StD).

Table 3. Population and breeding parameter analysis on hydrographic basins
3. táblázat Populációs és költési eredmények vízgyűjtő területenként

River basin	H		HPa		HPm		HPo		JZG		JZa		JZm		StD	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Ibri	36	38	34	36	33	34	2	2	107	102	76.9	72.53	76.9	72.53	0.85	0.90
M. e Binçes	18	19	15	16	15	15	0	1	47	48	21.5	19.81	21.5	20.34	0.96	1.02
Lepenci	17	17	15	15	14	14	0	1	51	44	37.5	36	37.5	36	2.19	2.19
Drini i Bardhë	9	9	9	9	9	9	0	0	32	30	21.5	20.25	21.5	20.25	0.19	0.19
Total	**80**	**83**	**73**	**76**	**71**	**72**	**2**	**4**	**237**	**224**	**3.25**	**2.95**	**3.34**	**3.11**	**0.67**	**0.70**

The highest breeding density (breeding pair/100 km^2) was recorded in the southeast part of Kosovo, in the locality Varosh, with a maximum of 114.29 breeding pairs/100 km^2 in 2017 and 100.0 in 2018. The lowest density occurs in the northern and western part of the country, located along the Drini i Bardhe river. The number of nests varies according to the hydrographic basins within Kosovo. Ibri basin is the most important. It contains the highest number of identified nests 38 (45.78%) followed by Morava e Binçes with 19 nests (22.89%), Lepenci 17 nests (20.48%), and the last one Drini i Bardhe with only 9 nests (10.84%).

The Biological population density (StDBiol), calculated by the total area of non-irrigated arable lands, pastures, lands principally occupied by agriculture with significant areas of natural vegetation and natural grasslands in the country (3,336.9 km^2), was 2.19 pairs/100 km^2 grassland in 2017 and 2.28 in 2018.

The lowest density of stork nests (0.19 nests/100 km^2) is within the Dukagjini Plain in the Drini i Bardhe river valley, while the highest nest density is in the Lepenci river valley (2.48 nests/100 km^2) and Morava e Binçes valley (1.21 nests/100 km^2). The average density of nests across the country was found to be quite low, only 0.76 nests/100 km^2. On the other hand, in this first national stork census conducted in Kosovo, the average breeding density (StD) was calculated as 0.67 breeding pairs per 100 km^2 in 2017 and 0.70 in 2018 *(Table 3)*.

Nest locality preferences

The majority (48.61%) of all recorded White Stork nests were located on various poles. Within this percentage, nests on overhead electricity line poles accounted for 82.35% of the total, whereas only 17.65% of nests were on communication line poles or those that were not in use any longer.

White Stork nests placed on the electricity pylons are considered to be at high risk of electrocution, collision or fire.

There are some recent focal activities to erect artificial nest platforms mostly in places where they are in a very dangerous situation.

After the poles, trees come with a ratio of 19.44% as nesting places. In addition, chimneys (9.72%), mobile phone antennae (8.33%), roofs (6.94%), and the top of mosques (6.94%) are among the preferred nesting places *(Figure 5, 6, Table 4)*.

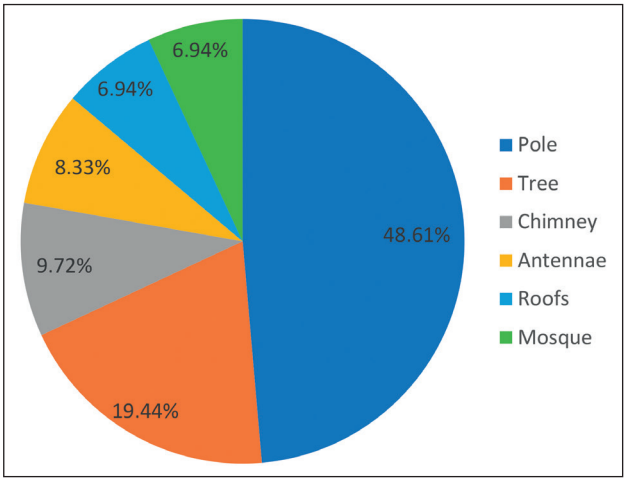

Figure 5. White Stork nest placements in Kosovo
5. ábra A fehérgólya-fészkek aljzat szerinti megoszlása Koszovóban

Reproductive Success

73 out of 80 nests occupied by nesting couples were detected in 2017 and 76 out of 83 nests in 2018. In two years, two nests were used by individuals

Figure 6. White Stork nests in various places
6. ábra Különböző helyekre épült fehérgólya-fészkek

Table. 4. Breeding success of the White Stork related to nest location in Kosovo
4. táblázat Költési eredmények a különféle fészekaljzatokon Koszovóban

Nest location	HPa		HPm		HPo		JZa		JZm	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Pole	33	36	32	35	1	2	3.22	3.03	3.22	3.08
Tree	16	16	15	14	0	2	3.06	2.65	3.06	2.65
Chimney	7	7	7	7	0	0	2.72	2.22	2.72	2.22
Roofs	5	5	5	5	0	0	3.12	3.04	3.12	3.04
Antennae	6	6	6	6	0	0	3.08	3.14	3.08	3.14
Mosque	6	6	6	5	1	0	3	2.57	3	2.57
Total:	73	76	71	72	2	4	3.25	2.95	3.34	3.11

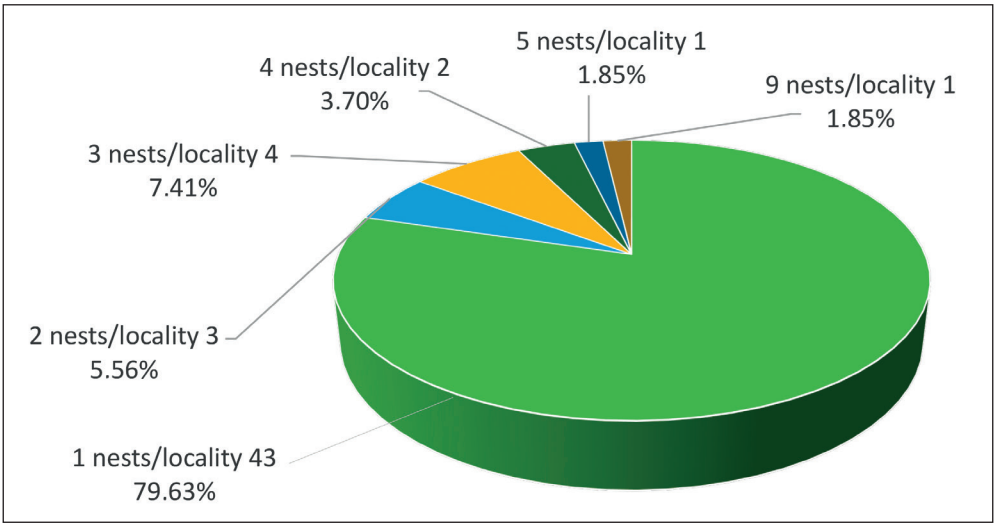

Figure 7. The distribution of the localities (54) by the number of nests (%)
7. ábra A települések megoszlása (%) az ott található gólyafészkek száma alapján

alone. It was found that five slots were not used in these years. 71 couples used the nests in 52 different areas in 2017 and 72 of them in 54 locations in 2018 were successful (HPm). Successful couples raised a total of 461 offspring, 237 in 2017 and 224 in 2018.

According to these data, the frequency distribution of the offspring size in 2017 and 2018 was calculated *(Figure 9)*. Accordingly, broods with three (HPm3) nestlings made up the highest proportion of nests with breeding success (52.94%) on average, was 39 in 2017 and 37 in 2018. Broods with four (HPm4) nestlings were also high, 18 in 2017 and 19 in 2018 while the broods with two (HPm2) nestlings was 11 in 2017 and 13 in 2018. The data about number of chicks per nests (HPm1 – HPm5) are in *Figures 8*.

During this census, the highest figures (HPa, StD) and the highest breeding success (JZm, JZa) were recorded in the areas along the Sitnica, Lepenci, and Morava e Binçes River.

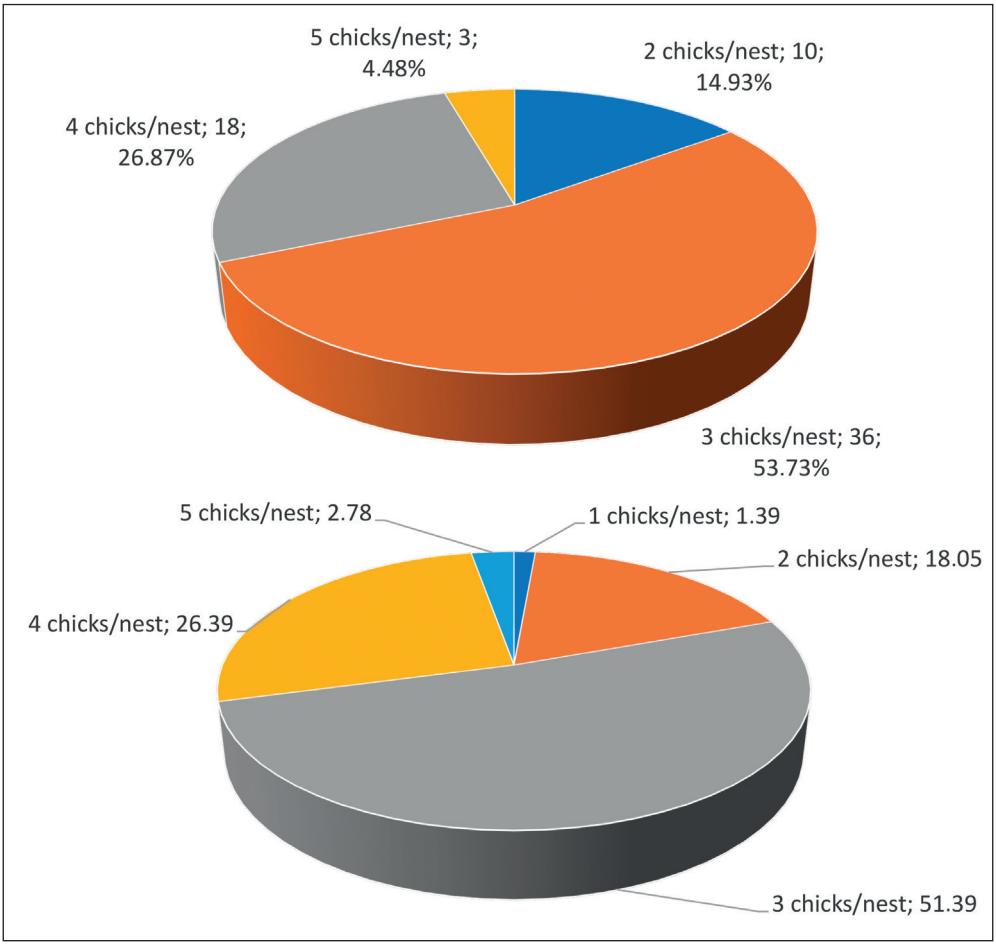

Figure 8. The nest distribution by the number of chicks / nests (2017 and 2018)
8. ábra A fészkek fiókaszám szerinti megoszlása (2017 és 2018)

Discussion

Phenology

The average dates of arrival of storks in Kosovo can be compared with Kosicki *et al.* (2004) for the storks in Poland. The first partner of a pair in our case arrived about 3–5 days earlier than the second partner. The difference of less than 7 days between the sexes were found from Barbraud *et al.* (1999) for the return date in France.

Distribution of nests

Based on the results carried out for the first time in 2014, when 22 nests were present (Maxhuni *et al.* 2016), during this research made in 2017–2018 with more search effort

61 new nests were found in the whole country territory and together with those 22 nests the total population is estimated to be 83 nests. This number is quite higher compared to the neighboring countries such as Montenegro where, according to Jovičevič and Saveljič (2012), is present only one nest and in Albania 4 nests (Bego *et al.* 2016). Our number of nests are lower comparing to Macedonia where 817 nests are present (Thomsen & Lachman 2013), while in Serbia there are 1,220–1,370 breeding pairs, where more than 77% of the population are in Vojvodina province (Puzovič *et al.* 2015).

In 54 localities, within 16 municipalities 83 nests were found with the mean number of nests/localities of 1.53. This mean number is very similar to those in Romania (Mestecaneanu *et al.* 2017), where this number was 1.85 and higher than those in Cluj County where this value was only 1.36 (Kosa 2015).

The highest concentration of breeding pairs along the Sitnica river can be explained due to favorable feeding conditions in the upper and central part of the basin, also by the fact that covering the surface of this hydrographic basin is among larger, excluding Drini i Bardhe river basin and, particularly in the temporarily flooded meadow and pastures that follow the river along both banks.

Population density

The average breeding density (StD) in Kosovo – 0.67 breeding pairs per 100 km^2 in 2017 and 0.70 in 2018 – is lower than in neighboring countries. Among them, in Slovenia the breeding density was 0.95–1.18 nests/100 km^2 (Denac 2010) in a period of 12 years (1999–2010), in Romania 4.33 (Kósa 2007), in Northern Croatia 7.55 (Mužinić & Hackenberger 2015). Exceptionally, the percentage of nests without nestlings (hPo) was lower than in many European countries (Gyalus *et al*. 2022).

During the breeding season, it has been proven that suitable feeding areas exist in many places along the Sitnica River Basin and near the nests; more or less the same results were found in Pomerania (Ożgo & Bogucki 1999), where the most visited habitats were meadows, grasslands and fields.

The reason for irregular distribution of White Stork nests per river basin might be the differences in food diversity and abundance (Tryjanowski & Kuveniak 2002, Tsachalidis & Goutner 2002). In addition, the distance to possible feeding sites (Johst *et al*. 2001), altitude and distance to the nearest river (Onmuş *et al*. 2012), differences in habitat structure and use (Moritzi *et al*. 2001, Nowakowski 2003).

Nest Location Preference

It has been determined that the stork nests built on trees were found only in three different tree species, consisting of oak, black locust, and lime tree. Similarly, the oak tree as a most common place of nest building has been found also in Lithuania (Vaitkuvienė & Dagys 2015). However, since nests built on buildings (chimney or roofs) are generally not welcome and storks are not allowed nesting there, the occupation rate of nests in buildings is lower than for pole nests, often because storks are not allowed to nest.

The oldest stork nest in Kosovo was estimated to be about 40 years old, the largest number of nests were between 6–10 years old. Even though the nests are in different areas, there was no significant difference in productivity between the old nests. While the number of nests on chimneys and trees has increased in the last 15–20 years compared to other areas with more nests, it has been determined that it has decreased (48.61%) in chimneys and trees. Similarly, the number of nests in chimneys is decreasing in many European countries. One reason for this is the modified shape of chimneys where the newer types are opened on the top in contrast with the ones that were earlier, with holes on the sides. Sometimes the top is cone-shaped, especially aiming to deter storks not to built the nest there (Gyalus *et al.* 2018).

During the last fifteen years, some changes have been observed in Kosovo in nest site preferences, birds moving from buildings to electricity pylons (Maxhuni *et al.* 2016) where the storks show the adaptability to the new conditions of life. This process has differed significantly in various parts of the country.

A higher nest location may provide a better and more secure landing and takeoff site for White Storks. Thus, some White Stork pairs trying to build nests on houses in villages may be disturbed by homeowners and build their nests on pylons (Onmuş *et al.* 2012).

Considering that overhead electricity line poles have been available across the countryside for many years (since 1960s), probably the recent increase in nesting on electricity poles is most likely a consequence of a gradual change in White Stork nesting behaviour in an increasing population. A similar tendency of White Storks increasingly nesting on overhead electricity line poles and gradually abandoning their former traditional nest sites in trees and on roofs of buildings has been observed over the last decades in several other European countries (Janaus & Stipniece 2004, Tryjanowski *et al.* 2009, Denac 2010, Onmuş *et al.* 2012). In Kosovo also, the decrease of nests in trees is present during the period from 2006 to now, while the proportion of nests on electricity line poles and cellsite antenae increased. Similarly, in other European countries such as Estonia, the proportion of nests in trees decreased from 68% in 1984 to less than 10% in 2008, while the proportion of nests on electricity line poles increased from 12% to 72% (Ots 2009). In Slovenia, the last White Stork nest in a tree was recorded in 2008 (Denac 2010). This same tendency has also been observed in Poland, both in the entire country, where the proportion of nests on electricity line poles increased from 4% in 1974 to 37% in 1995 (Jakubiec & Guziak 1998).

Nest position is known to have an important role in breeding success (Vergara & Aguirre 2006) and nest replacement or relocation may require caution as White Storks have high nest fidelity (Chernetsov *et al.* 2006, Vergara *et al.* 2006). In our case, especially in 2018, it has been observed in some cases that the placement of platforms on electric poles has resulted in the reduced success of the breeding of those nests, delaying the process of their reproduction and hatching the youngs.

Reproductive Success

Breeding success for the Kosovo stork population during our study, which was 3.19 per successful pair is a bit higher than the estimated JZm values needed to keep the population

stable (Burnhauser 1983, Lakeberg 1995). Although this value cannot be generalized since it is obtained in only two years (2017 and 2018), it is slightly higher than in other European countries where their breeding success has remained more or less unchanged. It was higher than in 2016 in Eastern Romania: 2.25 nestlings per nest (Fasolă-Mătăsaru 2018). Our data are more or less similar with those in Hungary (Lovászi 2022) where the breeding success in 2017 was 2.72 and in 2018 very similar to us: 3.15. The mean breeding success in Slovenia over the period 1999–2010 was 2.6 young per successful pair (Denac 2010). In Poland, which holds the largest population of White Storks (BirdLife International 2004), breeding success in various regions varied between 2.5 and 3.0 young per successful pair in the 1990s and early 2000s (Nowakowski 2003, Daniluk *et al*. 2006, Kuźniak 2006). In France, the mean breeding success was 2.5 young per successful pair in 2003 and 2004 (Massemin-Challet *et al*. 2006). In Slovakia, the mean breeding success during the period of 1978–2002 was 3.05 young per successful pair (Fulin *et al*. 2009). Considerably higher breeding success was recorded in Turkey, which holds one of the highest populations of White Stork (BirdLife International 2004), with 4.2 young per successful pair in central Turkey in 2004 (Göcek 2006) and 3.8 young per successful pair in northern Turkey in 2010 (Yavuz *et al*. 2012).

Our results related to the number of nestlings of birds (*Figure 8*) are in accordance with studies made in many countries like in Poland (Nowakowski 2003), Greece (Kominos & Galanali 2013) and in Romania (Mestecaneanu *et al*. 2017) with dominant proportion of HPm3 type broods, while in Cluj County (Romania) 4 young storks were the most common (Kósa & Papp 2015).

According to the results of our research, it is shown that the Kosovo White Stork population, which presumably belong to the south-eastern peripheral subpopulation (Stumberger & Velevski 2001), comparing with results from 1950 (Marčetić & Andrejevič) where 116 breeding pairs of White Storks were registered (hPa), shows decline since then. Similar declines were noted in the Macedonian Skopje basin (Micevski *et al*. 1992) and Albania (Peja & Bego 1999) but with lack of data about this situation in Serbia, Montenegro, and other surrounding countries. It is evident that in the countries of the southern Balkans we are facing negative population trends in the whole range of the species (Štumberger & Velevski 2001).

The availability of high-quality foraging sites close to the nest is one of the factors determining the breeding success of the White Storks (Kósa 2007). Habitat and food availability, in particular the food supply for adults feeding nestlings, and the breeding success of White Storks heavily depends on land use patterns and farming practices (Struwe & Thomsen 1991, Johst *et al*. 2001, Tryjanowski & Kuzniak 2002). Apart from a decrease in suitable habitats such as wetlands, possible reasons for the decrease in the number of storks include low rainfall, agricultural activities, and deaths during migration and in wintering areas.

In the case of the White Stork population air temperature and precipitation may influence breeding output in two ways: first, directly, because rainy days with low temperature are dangerous for eggs and small nestlings and indirectly by affecting potential food resources available to storks (Dawson & Bortolotti 2000, Pasinelli 2001, Tryjanowski & Kuzniak

2002, Gyalus *et al*. 2022). Then, reduced food availability and severe weather constitute stress factors often associate with parasite infections (Newton 1998).

A decrease in nestling survival when temperature falls may be due to a decrease in small prey availability since invertebrates are the main food intake during the first weeks of life and they are very sensitive to temperature (Djerdali *et al*. 2008). In our case, during the period 2017–2018 there was not any extreme weather conditions and we did not find the mortality scale in any cases.

White Stork arriving in Kosovo and other parts of Balkan and Europe in early spring, when the snow has not melted yet. Contrary to the study of Nowakowski and Wasilewska (2016), no relationship was found between breeding success and temperature because the average temperature in April in the study area was 10.9 °C, while in the work of Nowakowski and Wasilevska (2006) were 4.9 °C.

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References

Barbraud, C., Barbraud, J. C. & Barbraud, M. 1999. Population dynamics of the White Stork *Ciconia ciconia* in western France. – Ibis 141(3): 469–479. DOI: 10.1111/j.1474-919X.1999.tb04416.x

Bego, F., Rukaj, M., Bego, K. & Qirjo, M. 2016. Five year monitoring of breeding success of the White Stork (*Ciconia ciconia* L.) in Albania. – International Journal of Ecosystems and Ecology Science 6(4): 535–542.

BirdLife International 2004. Birds in Europe: Population Estimates, Trends and Conservation Status. – BirdLife International, Cambridge, UK, p. 47.

Burnhauser, A. 1983. Zur ökologischen Situation des Weißstorchs in Bayern [The ecological situation of the White Stork in Bavaria]. – Institut für Vogelkunde Garmisch-Partenkirchen 54: 1–488. (in German)

Chernetsov, N., Chromik, W., Dolata, P. T., Profus, P. & Tryjanowski, P. 2006. Sex-related natal dispersal of White Storks *(Ciconia ciconia)* in Poland: how far and where to? – The Auk 123(4): 1103–1109. DOI: 10.1093/auk/123.4.1103

Copernicus Land Monitoring Service 2018. CORINE Land Cover database, 2018. – European Environment Agency (EEA) https://land.copernicus.eu/

Daniluk, J., Korbal-Daniluk, A. & Mitrus, C. 2006. Changes in population size, breeding success and nest location of a local White Stork *Ciconia ciconia* population in Eastern Poland. – In: Tryjanowski, P., Sparks, T. H. & Jerzak, L. (eds.) The White Stork in Poland: Studies in Biology, Ecology and Conservation. – Bogucki Wydawnictwo Naukowe, Poznań, pp. 12–21.

Dawson, R. D. & Bortolotti, G. R. 2000. Reproductive success of American Kestrels: the role of prey abundance and weather. – Condor 102(4): 814–822. DOI: 10.1093/condor/102.4.814

Denac, D. 2010. Population dynamics of the White Stork *Ciconia ciconia* in Slovenia between 1999 and 2010. – Acrocephalus 31(145–146): 101–114. DOI: 10.2478/v10100-010-0007-4

Djerdali, S., Tortosa, F. S., Hillstrom, L. & Doumandji, S. 2008. Food supply and external cues limit the clutch size and hatchability in the White Stork *Ciconia ciconia*. – Acta Ornithologica 43(2): 145–150. DOI: 10.3161/000164508X395252

Fasolă-Mătăsaru, L., Ştefan Baltag, E., Ichim, P. & Cojocaru, D. 2018. Factors influencing the breeding success of White Storks *Ciconia ciconia* in Eastern Romania. – Ardeola 65(2): 271–282. DOI: 10.13157/arla.65.2.2018.ra6

Fulin, M., Jerzak, L., Sparks, T. & Tryjanowski, P. 2009. Relationship between arrival date, hatching date and breeding success of the White Stork *(Ciconia ciconia)* in Slovakia. – Biologia 64: 361–364. DOI: 10.2478/s11756-009-0037-3

Gyalus, A., Lovászi, P., Végvári, Zs. & Csörgő, T. 2022. Effects of climate variables on the White Stork (*Ciconia ciconia* L.) productivity in a long term study. – Ornis Hungarica 30(2): 61–74. DOI: 10.2478/orhu-2022-0020

Gyalus, A., Végvári, Z. & Csörgő, T. 2018. Changes in the nest sites of White Stork *(Ciconia ciconia)* in Hungary. – Ornis Hungarica 26(1): 65–88. DOI: 10.1515/orhu-2018-0005

Jakubiec, Z. & Guziak, R. 1998. Bocian biały *Ciconia ciconia* Polsce wroku 1995 – rozmieszczenie, liczebność, problemy ochrony [White Stork *Ciconia ciconia* in Poland in 1995 – distribution, abundance, problems of protection]. – Notatki Ornitologiczne 39(4): 195–209. (in Polish with English Summary)

Janaus, M. & Stipniece, A. 2004. Preliminary results of the White Stork *Ciconia ciconia* census in Latvia, 1994. – In: Anselin, A. (ed.) Bird Numbers 1995. Proceedings of the International Conference and 13th Meeting of the European Bird Census Council, Pärnu, Estonia. – Bird Census News, pp. 67–72.

Johst, K., Brandl, R. & Pfeifer, R. 2001. Foraging in a patchy and dynamic landscape: human land use and the White Stork. – Ecological Application 11(1): 60–69. DOI: 10.1890/1051-0761(2001)011[0060:FIAPAD]2.0.CO;2

Kaatz, C., Wallschläger, D., Dziewiaty, K. & Eggers, U. (eds.) 2017. Der Weißstorch [White Stork]. – VerlagsKG Wolf, Magdeburg (in German)

Kominos, T. & Galanaki, A. 2013. The White Stork Census in Greece, 2004/05. – In: Thomsen, K-M. & Lachman, L. (eds.) White Stork Populations Across the World. – Results of the 6th International White Stork Census 2004/2005. – NABU, Berlin

Kósa, F. 2007. Distribution, population size and dynamics of the White Stork (*Ciconia ciconia* L.) in Romania in 2004–2005. – In: Kósa, F. & Papp, T. (eds.) Distribution, Population Size and Dynamics of the White Stork (*Ciconia ciconia* L.) in Hârtibaciu Rivers Basin (Transylvania, Romania). – Transylvanian Review of Systematical and Ecological Research 4: 169–178.

Kosicki, J., Sparks, T. & Tryjanowski, P. 2004. Does arrival date influence autumn departure of the White Stork *Ciconia ciconia*. – Ornis Fennica 88: 91–95.

Kuźniak, S. 2006. White Stork *Ciconia ciconia* in South-Western Wielkopolska (Poland) in 1974, 1984 and 1994. – In: Tryjanowski, P., Sparks, T. H. & Jerzak, L. (eds.) The White Stork in Poland: Studies in Biology, Ecology and Conservation. – Bogucki Wydawnictwo Naukowe, Poznań, pp. 56–67.

Lakeberg, H. 1995. Zur Nahrungsökologie des Weißstorchs *Ciconia ciconia* in Oberschwaben" (S-Deutschland): Raum-Zeit-Nutzungsmuster, Nestlingsentwicklung und Territorialverhalten [On the feeding ecology of the White Stork *Ciconia ciconia* in Oberschwaben (S-Germany): space-time usage patterns, nestling development and territorial behavior]. – Ökologie der Vögel 17: 1–87. (in German)

Mann, H. B. & Whitney, D. R. 1947. On a test of whether one of two random variables is stochastically larger than the other. – Annals of Mathematical Statistics 18(1): 50–60.

Marčetić, M. & Andrejević, D. 1960. Ornitofauna Kosova i Metohije [Ornithofauna of Kosovo and Metohija]. – Rilindja, Prishtine (in Serbian)

Massemin-Challet, S., Gendner, J. P., Samtmann, S., Pichegru, L., Wulgué, A. & Le Maho, Y. 2006. The effect of migration strategy and food availability on White Stork *Ciconia ciconia* breeding success. – Ibis 148(3): 503–508. DOI: 10.1111/j.1474-919X.2006.00550.x

Maxhuni, Q., Morina, I., Morina, R., Ferizi, R. & Hashani, Z. 2014. Biodiversity and protected areas in Kosovo. – International Journal of Ecosystems and Ecology Sciences (IJEES) 4(1): 173–178.

Maxhuni, Q., Karataş, A., Ferizi, R. & Hashani, Z. 2016. The nesting sites of the White Stork *Ciconia ciconia* in Kosovo in 2014. – In: Jerzak, L., Shephard, J., Aguirre, J. I., Shamoun-Baranes, J. & Tryjanowski, P. (eds.) The White Stork: Studies in Biology, Ecology and Conservation. – Oficina Wydawnicza Universytetu Zielonogórskiego, Zielona Góra, pp. 63–71.

Maxhuni, Q., Fiedler, W., Karataş, A. & Hoxha, L. 2018. Satellite tracking and migration routes of Kosovo White Stork *(Ciconia ciconia)*. – International Eurasian Ornithology Congress, 23–27 April, Heidelberg, Germany

Mestecaneanu, A., Gava, R. & Mestecaneanu, F. 2017. The census of the White Stork (*Ciconia ciconia* Linnaeus, 1758) from Argeş country, in 2014. – Studii şi Comunicări Ştiinţele Naturii 33(2): 119–132.

Micevski, B., Stojanovski, L. & Sterjova, B. 1992. Drastic decrease of population density of White Stork *Ciconia ciconia* in Macedonia. – Ciconia 4: 43–49.

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 seasoning Switzerland. – Ardea 89(3): 457–470.

Mužinić, J. & Hackenberger, K. 2015. Census and population dynamics of the White Stork *Ciconia ciconia* in Croatia in the years 2004/05. – Annual Research and Review in Biology 7(1): 23–38. DOI: 10.9734/ARRB/2015/16901

Nowakowski, J. J. 2003. Habitat structure and breeding parameters of the White Stork *Ciconia ciconia* in the Kolno Upland (NE Poland). – Acta Ornithologica 38: 39–46. DOI: 10.3161/068.038.0109

Nowakowski, J. J. & Wasilewska, B. 2006. The relationship between spatial distribution, intrapopulation competition and the reproduction parameters of White Stork *Ciconia ciconia* in the southern basin of the Biebrza River during the years 1994–1999. – In: Tryjanowski, P., Sparks, T. H. & Jerzak, L. (eds.) The White Stork in Poland: Studies in Biology, Ecology and Conservation. – Bogucki Wydawnictwo Naukowe, Poznań, pp. 99–113.

Onmuş, O., Ağaoğlu, Y. & Gül, O. 2012. Environmental factors affecting nest-site selection and breeding success of the White Stork *(Ciconia ciconia)* in western Turkey. – Wilson Journal of Ornithology 124: 354–361. DOI: 10.1676/11-155.1

Ots, M. 2009. The White Stork *(Ciconia ciconia)* in Estonia till year 2008. – Hirundo 22: 32–42.

Ożgo, M. & Bogucki, Z. 1999. Home range and intersexual differences in the foraging habitat use of a White Stork *(Ciconia ciconia)* breeding pair. – In: Schulz, H. (ed.) Weißstorch im Aufwind? – White Storks on the up? – Proceedings International Symposium on the White Stork, 26–29th September 1996 Hamburg. NABU, Bonn, pp. 481–492.

Pasinelli, G. 2001. Breeding performance of the Middle Spotted Woodpecker *Dendrocopos medius* in relation to weather and territory quality. – Ardea 89: 353–361.

Peja, N. & Bego, F. 1999. On the situation of the White Stork *(Ciconia ciconia)* in Albania 1995. – In: Schulz, H. (ed.) Weißstorch im Aufwind? – White Stork on the up? – Proceedings International Symposium on the White Stork, 26–29 th September 1996 Hamburg. NABU, Bonn, pp. 223–227.

Pelle, Z. 1999. Status and biology of the White Stork in Yugoslavia. – In: Schulz, H. (ed.) Weißstorch im Aufwind? – White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 th September 1996, Hamburg. NABU, Bonn, pp. 219–222.

Puzović, S., Radišić, D., Ružić, M., Rajković, D., Radaković, M., Pantović, U., Janković, M., Stojnić, N., Šćiban, M., Tucakov, M., Gergelj, J., Sekulić, G., Agošton, A. & Raković, M. 2015. Ptice Srbije: Procena veličina populacija i trendova gnezdarica 2008–2013 [Birds of Serbia: Assessment of population sizes and trends of nesting birds 2008–2013]. – Društvo za zaštitu i proučavanje ptica Srbije i Departman za biologiju i ekologiju, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad (in Serbian)

Schulz, H. 1999. The world population of the White Stork *(Ciconia ciconia)*: Results of the 5th International White Stork Census 1994/95. – In: Schulz, H. (ed.) Weißstorch im Aufwind? − White Storks on the up? Proceedings International Symposium on the White Stork, 26–29 th September 1996, Hamburg. NABU, Bonn, pp. 351–366.

Struwe, B. & Thomsen, K. M. 1991. Studies on the feeding ecology of White Storks (*Ciconia ciconia*, L.) at Berenhusen (Schleswig-Holstein, Germany) 1989. – Corax 14: 210–238.

Štumberger, B. & Velevski, M. 2002. White Stork *Ciconia ciconia* survey in Pelagonia indicates a decrease in its breeding population and colony disintegration. – Acrocephalus 23(112): 67–74.

Thomsen, K-M. & Lachman, L. (eds.) 2013. White Stork Populations Across the World. – Results of the 6th International White Stork Census 2004/2005. NABU, Berlin

Tryjanowski, P., Kosicki, J. Z., Kuźniak, S. & Sparks, T. H. 2009. Long-term changes in, and breeding success in relation to, nesting structures used by the White Stork *Ciconia ciconia.* – Annales Zoologici Fennici 46: 34–38.

Tryjanowski, P. & Kuźniak, S. 2002. Population size and productivity on the White Stork *Ciconia ciconia* in relation to Common Vole *Microtus arvalis* density. – Ardea 90: 213–217.

Tsachalidis, E. P. & Goutner, V. 2002. Diet of the White Stork in Greece in relation to habitat. – Waterbirds 25: 417–423.

Vaitkuvienė, D. & Dagys, M. 2015. Two-fold increase in White Stork *(Ciconia ciconia)* population in Lithuania: a consequence of changing agriculture. – Turkish Journal of Zoology 39(1): 144–152. DOI: 10.3906/zoo-1402-44

Vergara, P., Aguirre, J. I., Fargallo, J. A. & Dávila, J. A. 2006. Nest-site fidelity and breeding success in the White Stork *Ciconia ciconia*. – Ibis 148(4): 672–677. DOI: 10.1111/j.1474-919X.2006.00565.x