

# ANALYSIS OF REPRODUCTIVE TRAITS IN THE PAINTED STORK (*MYCTERIA LEUCOCEPHALA*)

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## Abstract

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The aim of the present study was focused on analysis of reproductive traits in the painted stork (*Mycteria leucocephala*). The analysis of partial reproductive traits was intended to complete the knowledge necessary for ensuring reproduction of the painted stork in captivity on the required level. The observation was performed in the Zoo Zlín – Lešná from 2011 to 2014. The eggs were measured and weighed after laying and then in several-day intervals. Other observed traits were hatchability of the eggs, number of raised young birds and their weight after hatching. During whole observation period, a total of 90 eggs of the painted stork were evaluated from 12 parental pairs. The average share of fertilized eggs was 38.9%. Average length of eggs was 68.57 mm, average width was 46.43 mm and average weight was 79.79 g. Average weight loss of eggs during their incubation was 9.87 g. Average hatchability of all the laid eggs was 27.8%. Average hatchability of the fertilized eggs was 71.4%. A total of 23 young painted storks were hatched during the observation period. Their average hatching weight was 57.04 g. The overall number of 11 individuals were raised during the four years of observation.

Keywords: *mycteria leucocephala*, painted stork, ciconiiformes, waterbird reproduction

## INTRODUCTION

Although the painted stork belongs to the most numerous representatives of Asian storks, there has been a significant decrease in its numbers recently. The causes are mainly hunting, drying of wetlands, environmental pollution and climatic changes (Sundar *et al.*, 2015, Urfi, 2011a). Also their naturally preferred food is a limiting factor (Urfi, 2011b). The painted stork is found in the wild of Asia, mainly in India and Sri Lanka (Ong *et al.*, 2012). According to the International Union for Conservation of Nature (IUCN) classification, the painted stork belongs to the category of NT – Nearly Threatened species (BirdLife International, 2016). The aims of this work were mainly focused on analysis of reproductive traits in the painted stork. The analysis of partial reproductive traits, namely: the number

of eggs, egg weight evaluation during incubation, hatchability and hatching weight of birds completed the knowledge necessary for the required level of reproduction of the painted stork in captivity.

## MATERIALS AND METHODS

The observation took place in the Zoological garden Zlín – Lešná. Over the 4-year time period, reproductive and related traits of the painted stork were analysed. In total, 11 individuals of the painted stork, which created 12 parental pairs, were observed during the four years of evaluation.

The painted storks were bred seasonally. In summer season (from April to October) they were kept in outdoor aviaries and in winter season (from November to March) they were housed indoors. For better nesting, boards (60×60 cm) that served

as the basis for building of nests, were placed on the trees in the outdoor aviaries.

The eggs were measured and weighed after laying and then again in several day intervals. The length of the intervals ranged from 5 to 10 days, in order to respect behaviour of the birds and to disturb the nesting activities as little as possible. The control of the nest was not possible without the parenting pair leaving the nest, however every time they returned within a few minutes after weighing of the eggs.

The following traits were analysed during the observation period:

- Number of eggs laid in individual years of observation (total number of eggs, share of fertilized eggs, unfertilized and damaged eggs).
- Length, width and weight of eggs in individual years of observation.
- Egg weight loss during incubation in individual years of observation.
- Hatchability and number of raised young birds in individual years of observation.
- Weight of young birds at hatching in individual years of observation.

Statistical analysis of the data was performed using statistical software STATISTICA 12.0., ANOVA was used to determine the effect of year of laying on the observed parameters, length and width of eggs, their weight at the time of laying and during incubation and the weight of hatched young birds. LSD-test, of the post hoc tests, was used for significance determination of the differences among the years of observation.

## RESULTS AND DISCUSSION

### Evaluation of egg numbers

During the whole observation period, a total of 90 eggs of the painted stork were evaluated. The highest number of eggs was recorded in 2014 with 28 eggs laid, the lowest number of eggs (14) was laid in 2011 (Tab. I).

The average share of the fertilized eggs for the whole period was 38.9% (35 eggs). The lowest share of fertilized eggs was observed in 2011, when only 28.6% (4 eggs) were fertilized. On the contrary, the highest share of fertilized eggs was found in 2013, when 48.2% (13 eggs) were fertilized.

Damaged eggs were found only in three years of observation and their average share was 18.9% (17 eggs). No damaged eggs occurred in the second year of observation. The highest share of damaged eggs was recorded in 2011 with 57.1% (8 eggs).

### Evaluation of dimensions and weight of eggs

During the whole observation, the average length of the painted stork eggs was 68.57 mm, the average width of eggs was 46.43 mm and the average weight was 79.79 g (Tab. II).

The longest eggs were found in 2011, when the average length of eggs reached 70.30 mm. On the contrary, the shortest eggs were observed in 2014, when their average length was 67.68 mm, which is 2.62 mm less than in 2011. The values of the average length of eggs in 2011 and 2014 are statistically significantly different ( $p \leq 0.05$ ), in 2014 the eggs were shorter than in 2011. The observed values correspond to the data found in literature. Brehm (1926) states that eggs of the painted stork are 7 cm long and Urfi (2011c) documented a range

I: Evaluation of egg numbers in the painted stork

Factor		Total number of eggs [n]	Fertilized eggs [%]	Unfertilized eggs [%]	Damaged eggs [%]
Year	Total	90	38.9	42.2	18.9
	2011	14	28.6	14.3	57.1
	2012	21	42.9	57.1	0
	2013	27	48.2	37.0	14.8
	2014	28	32.1	50.0	17.9

II: Evaluation of the dimensions and weight of the painted stork eggs

Factor	n	Length of eggs [mm]		Width of eggs [mm]		Weight of eggs [g]	
		$\bar{x}$	$s_x$	$\bar{x}$	$s_x$	$\bar{x}$	$s_x$
Total	80	68.57	3.02	46.43	1.86	79.79	5.57
2011	12	70.30 <sup>a</sup>	2.89	46.55	1.65	82.59 <sup>Aa</sup>	5.08
2012	19	68.48	3.34	46.28	2.88	81.37	5.55
2013	25	68.63	2.83	46.60	1.57	80.01 <sup>b</sup>	5.27
2014	24	67.68 <sup>b</sup>	2.80	46.30	1.18	76.90 <sup>B</sup>	5.17

$p \leq 0.01$  : A – B,  $p \leq 0.05$  : a – b

from 66 to 75 millimetres, which is in accordance with the results of the present work.

The widest eggs were found in 2013 and they measured 46.60 mm. The narrowest eggs were from 2012, when their width was only 0.32 mm lower than in 2013 and their average width reached 46.28 mm. The average width of the painted stork eggs was rather constant all over the period and there were no statistically significant differences among the individual years. The observed values are in accordance with the data found by Urfi (2011c) who described a range from 41.5 mm to 48 mm. However, Brehm (1926) states that eggs of the painted stork are only 3.5 mm wide, which is a value significantly different (by 1.1 mm) from the average width of the painted stork eggs observed in this study.

The weight of eggs varied in the individual years of observation. The heaviest eggs were laid in 2011, when their average weight reached 82.59 g. On the contrary, the eggs with the lowest weight were found in 2014 with the average value lower by 5.69 g than in 2011 (76.90 g). There were statistically significant differences found between the individual years in the average weight of eggs. A statistically significant difference ( $p \leq 0.01$ ) was found between the years 2011 and 2014, when the eggs reached significantly lower weight. Also the difference between the weight of eggs in 2011 and 2013 was statistically significant ( $p \leq 0.05$ ) with lower values recorded in 2013.

#### Evaluation of egg weight loss during incubation

During the whole observation period, the average weight loss in the eggs of the painted stork during their incubation was 9.87 g. The average daily egg weight loss during incubation reached 0.41 g (Tab. III). Pores of the egg shell allow oxygen to permeate into the egg and carbon dioxide and water

vapour to be discharged, which causes the weight loss of eggs during incubation (Tazawa and Whittow, 2000). The embryo does not begin to develop until incubation is started (Burnie, 2008). Adult birds then play a key role in generation of heat, but also in ensuring the optimal microclimate during egg incubation (Tazawa and Whittow, 2000).

The lowest weight loss in eggs during their incubation was recorded in 2014 (8.37 g). The highest weight loss in eggs during their incubation was found in 2012 (12.44 g), which is 4.07 g more than in 2014. There were statistically significant differences found among the individual years of observation. Statistically significant ( $p \leq 0.05$ ) were the differences between the year 2012 and the years 2013 and 2014, when the weight losses in eggs during incubation reached lower values. Etches (1996) documented, that an acceptable level of hatchability in chicken is associated with egg weight loss between 10–15%. This value was also achieved in this work with average egg weight loss between 10.8% and 15.3%

In 2014 the average daily weight loss during incubation reached the lowest value (0.36 g). On the contrary, the highest average daily weight loss during incubation was recorded in 2011 (0.45 g). No statistically significant differences were found among individual years of observation in the average daily weight loss in eggs during incubation.

#### Evaluation of numbers of hatched and raised young birds

The average hatchability of the painted stork for the whole observation time was 27.8% and the average hatchability of the fertilized eggs for the same period was 71.4%. In total, 23 young birds hatched and 11 individuals of the painted stork were raised during the whole period of observation (Tab. IV).

III: Egg weight loss during incubation in the painted stork

Factor	n	Total weight loss [g]		Average daily weight loss [g]		
		$\bar{x}$	$s_x$	$\bar{x}$	$s_x$	
<b>Total</b>	76	9.87	4.79	0.41	0.22	
<b>Year</b>	2011	8	11.56	6.90	0.45	0.15
	2012	19	12.44 <sup>a</sup>	4.25	0.42	0.17
	2013	25	8.68 <sup>b</sup>	5.39	0.44	0.12
	2014	24	8.37 <sup>b</sup>	2.56	0.36	0.12

$p \leq 0.05$  : a – b

IV: Numbers of hatched and raised young painted storks

Factor	Hatchability [%]		Number of hatched birds [n]	Number of raised birds [n]
	of all eggs	of fertilized eggs		
<b>Total</b>	27.8	71.4	23	11
<b>Year</b>	2011	21.4	3	0
	2012	33.3	7	4
	2013	22.2	5	1
	2014	32.1	100.0	8

## V: Weight of young painted storks

Factor	Weight at hatching [g]		
	n	$\bar{x}$	$s_x$
<b>Total</b>	23	57.04	7.01
Year	2011	3	58.63
	2012	7	54.30
	2013	5	63.50 <sup>a</sup>
	2014	8	53.99 <sup>b</sup>

$p \leq 0.01$ : A – C,  $p \leq 0.05$ : a – b

Regarding the hatchability of the total number of eggs, the most successful year was 2012, when the percentage of hatched eggs was 33.3% of the total number of eggs. On the other hand, the least successful year was 2011 when the average hatchability reached 21.4% of the total number of eggs.

The maximum hatchability (100%) of the fertilized eggs was achieved in 2014, on the contrary the least successful year in terms of hatchability of the fertilized eggs was 2013 with average value 46.2%.

The most successful year regarding the number of hatched birds was 2014, when 8 young painted storks were hatched. The least successful year was 2011 with only 3 hatched young birds.

Regarding the number of raised storks, the most successful year was 2014 again, when

6 young painted storks were successfully raised, the efficiency of raising was 75%. On the contrary, the least successful year was 2011 with no individual raised.

### Evaluation of young birds' weight

Throughout the evaluation period, the average weight of the young painted storks at the time of hatching was 57.04 g (Tab. V).

The highest average weight of the young birds at the time of hatching (63.50 g) was observed in 2013. In 2014, the average value of this trait was the lowest (53.99 g), which is by 9.51 g lower than in 2013. Differences between the individual years were statistically significant. A statistically significant difference ( $p \leq 0.05$ ) was found between the years 2014 and 2013.

## CONCLUSION

Throughout the observation period, a total of 90 eggs of the painted stork were evaluated. The average share of the fertilized eggs for the whole period was 38.9% (35 eggs).

Following characteristics of the painted stork eggs were recorded: The average length of the eggs was 68.57 mm, the average width of the eggs was 46.43 mm and the average weight of the eggs was 79.79 g. The recorded values of the length of the eggs are in accordance with the data found in literature. However, Brehm (1926) states that the eggs of the painted stork are 3.5 cm wide, which is a value significantly different (by 1.1 cm) from the average width of the painted stork eggs recorded in this study.

The average weight loss of the painted stork eggs during their incubation for the whole observation period was 9.87 g. The value ranged from 10.8% to 15.3%.

The average hatchability of all the laid eggs was 27.8%. The average hatchability of the fertilized eggs reached 71.4%. The overall number of hatched young storks for the whole observation period was 23. Their average weight on the day of hatching was 57.04 g. During the four years of observation, a total of 11 individuals of the painted stork were raised.

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