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SOME BREEDING TRAITS OF THE PIED WAGTAIL (*MOTACILLA ALBA*) IN NW CROATIA

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In this study, some key aspects of the breeding performance of the pied wagtail are reported for the first time in northwestern Croatian. Only first clutches are included. The average egg length was 20.04 mm, breadth = 14.96 mm, volume = 2276.41 mm^3 and egg shape index = 1.34. Egg dimensions and shape index did not vary significantly among the years in the study period (2006 to 2008). Egg size differences of the pied wagtail in different clutch size classes were also not significant. Egg length and egg breadth had the significant positive correlation. Average full clutch size for three years combined was 5.29, ranged from four to six eggs and modal clutch size was five (63.1 %). There was no significant difference in clutch size across the three years. We did not find any evidence for negative or positive relationships between clutch size and egg size in the researched bird species.

Key words: pied wagtail, egg dimensions, clutch size, northwestern Croatia

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U ovome radu prezentiraju su neki od parametara gniježđenja bijele pastirice na području sjeverozapadne Hrvatske. Istraživanje je obuhvaćalo razdoblje od 2006. do 2008. godine. U analizu je uključeno samo prvo gniježđenje u sezoni. Prosječna duljina jaja iznosila je 20,04 mm, širina 14,96 mm, volumen 2276,41 mm^3 i indeksa oblika jaja 1,34. Dimenzije jaja kao i njihov oblik nisu bili značajno različiti tijekom istraživanih godina. Zabilježen je značajan pozitivni suodnos između dužine i širine jaja. Prosječno je u gnijezdu bilo 5,29 jaja (minimalno 4, maksimalno 6) – najčešće pet (63,1 %). Veličina pologa nije značajno varirala između godina istraživanja. Također nije bilo značajne povezanosti, bilo pozitivne ili negativne, između veličine jaja i veličine pologa.

Ključne riječi: bijela pastirica, dimenzije jaja, veličina pologa, sjeverozapadna Hrvatska

INTRODUCTION

Egg size (volume or mass) can vary with ambient temperature (e.g. SAINO *et al.*, 2004), parental age (e.g. FLINT & SEDINGER, 1992), female mass (e.g. JÄRVINEN, 1991), body condition of female (e.g. AMAT *et al.*, 2001), position in the laying sequence (e.g. DOLENEC, 2004), interannual differences (e.g. BUDDEN & BEISINGER, 2005), seasonal variations (e.g. HILL *et al.*, 1984), climate change (e.g. JÄRVINEN, 1994), genetic

component (e.g. STYRSKY *et al*., 2002), nutrient constraints (e.g. O'CONNOR, 1979) landscape composition (BALL *et al*., 2002) and other factors. Attention has recently been focused on egg size and clutch size variation as one of several indicators of the mechanisms for regulation of reproductive success. In numerous bird species, large eggs produce large offspring which may grow and survive more successfully than offspring hatched from small eggs (e.g. WILIAMS, 1994; MERILÄ & SHELDON, 2001). Directional selection should favour the production of larger eggs by females (AMAT *et al*., 2001), but egg size combined with clutch size constitutes a major energetic investment of females (ZIELIŃSKI & BAŃBURA, 1998). According to HÕRAK *et al*. (1995), the size of eggs to lay is one of the first problem that an individual bird faces at the beginning of the reproductive cycle.

In this paper I demonstrate interannual variation in egg dimensions (length, breadth, volume, shape index) and clutch size of the pied wagtail (*Motacilla alba*). There are many studies on egg dimensions in passerine bird species (e.g. YOU *et al*., 2009), but only in a few cases has the research been focused on egg dimensions and clutch size of the pied wagtail (e.g. LEINONEN, 1973). The researched species is a small migratory and insectivorous passerine bird. The population breeding in the research area (NW Croatia) belongs to the subspecies *Motacilla alba alba* (VAURIE, 1959). The first birds arrive in the Hrvatsko Zagorje area in the end of the February and early March, the first records ranging from 24 February to 5 March with a mean of 2 March (DOLENEC, 2003). To my knowledge, no other egg characteristic data of importance have been published for this species in Croatia.

MATERIALS AND METHODS

Pied wagtail were studied in Hrvatsko Zagorje rural area (45°58' – 46°10'N, 15°50' – 16°08'E) in northwestern Croatia. The study was carried out in villages, on a total of 46 nests during 2006–2008. All nests were placed in semi–holes in houses, garages, farm buildings etc. In the research period, both frequency of visits and time spent at an occupied nest were minimized. The maximum number of visits to nest stages was four. In northwestern Croatia the pied wagtail regularly lays two or three clutches per reproductive season (unpublished). Only the mean values of the first clutch were analysed in this study while second and third clutches were not included in the study. Clutch size was considered as the maximum number of eggs found in the nest. Egg length (maximum) and egg breadth (maximum) were measured with »Somet« callipers to the nearest 0.01 mm.

The egg volume was calculated using the formula (HOYT, 1979):

$$\text{VOLUME (V)} = 0.51 \times \text{LENGTH (L)} \times \text{BREADTH}^2 \text{ (B)}$$

Egg shape index was calculated using the formula:

$$\text{EGG SHAPE INDEX (ES): LEGTH/BREADTH}$$

This method was previously used on many bird species (e.g. BRISKIE & SEALY, 1990; DOLENEC, 2006).

The non-parametric Kruskal-Wallis test was used to examine differences in egg dimensions, egg shape index and clutch size during the three years. A possible correlation between egg length and egg breadth was tested using Pearson's correlation. The same test was used to investigate the correlation between clutch size and

egg size. All statistical analyses were performed using SPSS 13.0. Values are presented as means and standard deviations (SD). Significance tests were considered significant $p \leq 0.05$.

RESULTS AND DISCUSSION

I determined egg dimensions and clutch size for 46 nests in a three year period, from 2006 to 2008. The average egg length was 20.04 mm (± 0.68), CV (coefficient of variation) = 3.3 %), egg breadth – 14.96 mm (± 0.35), CV = 2.3 %, egg volume – 2276.41 mm^3 (± 178.69), CV = 7.8 % and egg shape index – 1.34 (± 0.069), CV = 5.2 %. (Tab. 1). No differences in egg dimensions among the three years were found (Kruskall-Wallis test; length – $\chi^2 = 0.66$, df = 2, p = 0.716, breadth – $\chi^2 = 1.49$, df = 2, p = 0.474, volume – $\chi^2 = 0.97$, df = 2, p = 0.615, egg shape index – $\chi^2 = 2.34$, df = 2, p = 0.311; Tab. 2). The mean egg dimensions of the pied wagtail in my study area were similar to those found by other authors in Europe. For example, egg length in the Netherlands was 19.9 mm and egg breadth 15.0 mm, and in Belgium 20.1 mm and 15.0 mm (see VERHEYEN, 1967). Egg length and egg breadth were significantly positive correlated (Pearson's correlation; r = 0.564, p<0.001, N = 46; Fig. 1). A positive relationship between egg length and breadth is common in birds. For instance, studies of the semipalmated plover (*Charadrius semipalmatus*) in Canada (NOL *et al.*, 1997), the collared flycatcher (*Ficedula albicollis*) in Poland (MITRUS & ROGALA, 2001) and the hooded crow (*Corvus cornix*) in Croatia (DOLENEC, 2008) all showed similar results.

Average clutch size was 5.36 (SD = 0.49, range = 5 to 6, N = 14), 5.18 (SD = 0.53, range = 4 to 6, N =17) and 5.33 (SD = 0.49, range 4 to 6, N = 15) eggs in 2006, 2007 and 2008 respectively (Tab. 1). There was no interannual difference in clutch size (Kruskall-Wallis test, $\chi^2 = 1.05$, df = 2, p = 0.593). Total average clutch size (2006–2008) was 5.29 (SD = 0.54, range = 4 to 6, N = 46) eggs (only first clutches included). Modal clutch size was five (63.1 %, Fig. 2). The clutch size of the pied wagtail in northwestern Croatia is consistent with the findings of similar studies in

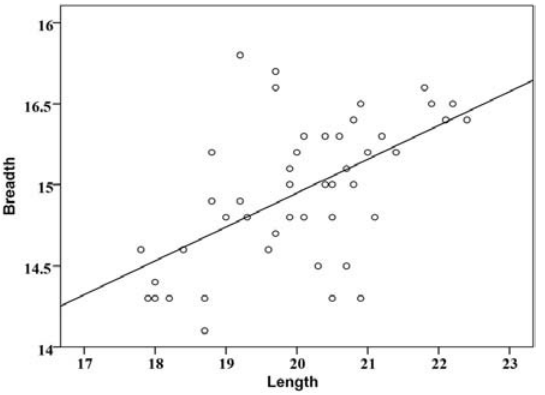

Fig. 1. Correlation between egg length (mm) and egg breadth (mm) of the pied wagtail (northwestern Croatia), 2006–2008. Only first clutches are included.

Tab. 1. Some breeding parameters of pied wagtail females (northwestern Croatia), 2006–2008. Only first clutches are included. Total number of clutches = 46

Parameters	Range	Mean	± SD
Egg length (mm)	17.8 – 22.4	20.04	0.68
Egg breadth (mm)	14.1 – 15.8	14.96	0.35
Egg volume (mm³)	1521.6 – 2720.1	2276.41	197.91
Egg shape index	1.22 – 1.46	1.34	0.069
Clutch size	4 – 6	5.28	0.54

Tab. 2. Interannual egg dimensions of the pied wagtail females (northwestern Croatia), 2006–2008. Only first clutches are included. Number of clutches: 2006 = 14, 2007 = 17, 2008 = 15. P-values was not-significant (Kruskall-Wallis test)

Parameters	Year			p
	2006	2007	2008	
Egg length (mm)				
Range	18.0 – 22.1	17.8 – 22.2	17.9 – 22.4	–
Mean	20.11	20.09	19.91	0.716
± SD	0.71	0.74	0.63	–
Egg breadth (mm)				
Range	14.3 – 15.6	14.1 – 15.7	14.3 – 15.8	–
Mean	14.87	14.92	15.07	0.474
± SD	0.34	0.34	0.36	–
Egg volume (mm³)				
Range	1877.2 – 2705.7	1521.6 – 2720.1	1898.1 – 2709.3	–
Mean	2285.6	2221.3	2330.4	0.615
± SD	266.06	276.21	221.52	–
Egg shape index				
Range	1.25 – 1.44	1.22 – 1.46	1.22 – 1.45	–
Mean	1.36	1.34	1.32	0.311
± SD	0.066	0.073	0.067	–

Fig. 2. Clutch of pied wagtail (*Motacilla alba*) with five eggs (Photo: Z. Dolenec)

some other European countries (e.g. MASON & LYCZINSKI, 1980), but not all (see LEINONEN, 1973). The combination of clutch size and egg size determines the total energetic investment in clutch formation by a female (FLINT & SEDINGER, 1992). We did not find any evidence for significant negative or positive relationship between clutch size and egg size in the researched bird species (Pearson's correlation; $r = -0.22$, $p = 0.136$, $N = 46$). According to SMITH & FRETWELL (1974), the trade–off between these parameters is critical for understanding the evolution of reproductive behaviour. However, empirical research generally does not support such a hypothesized trade-off (e.g. STILLMAN *et al*., 1998; DOLENEC *et al*., 2007; DOLENEC *et al*., 2008). According to van NOORDWIJK & JOUNG (1986), high quality females may produce both a large clutch and large eggs.

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SAŽETAK

Neka obilježja gniježđenja bijele pastirice (*Motacilla alba*) u sjeverozapadnoj Hrvatskoj

Z. Dolenec

O biologiji gniježđenja bijele pastirice u našoj literaturi nema podataka, a to se velikim dijelom odnosi i na druge europske zemlje. Posebice je danas potrebno istraživati biologiju gniježđenja kada je antropogeni čimbenik sve prisutniji u mnogim ekosustavima. Nadalje, sve više radova govori o utjecaju (ili mogućem utjecaju) klimatskih promjena (prije svega temperature) na živi svijet (npr. PARMESAN, 2006). Stoga je »snimka« bilo kojih varijabli gniježđenja ptica od velike važnosti za daljnji tijek ornitoloških istraživanja, primjerice, fenologije, demografije… I u nas su dokumentirane promjene u fenologiji nekih vrsta, posebice ptica. Tako se primjerice, golubovi grivnjaši (*Columba palumbus*) (DOLENEC & DOLENEC, 2010) i piljci (*Delichon urbica*) (DOLENEC & DOLENEC, 2011) sve ranije vraćaju sa zimovanja, a lastavice (*Hirundo rustica*) (DOLENEC *et al*., 2009) i poljski vrapci (*Passer montanus*) (DOLENEC *et al*., 2011) sve ranije gnijezde.