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BREEDING CHARACTERISTICS OF THE BARN SWALLOW (*HIRUNDO RUSTICA*) IN NW CROATIA

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The research was carried out in the village of Mokrice (46°00'N, 15°55'E) in NW Croatia during 1998–1999. Egg length averaged 19.16 mm, egg breadth 13.72 mm, egg volume 1840.8 mm^3, egg shape index 1.40 and egg weight 1.81 g (during both years). The nests were situated at a height of 1.5–4.5 m above ground (mean = 2.5 m). I found 2–7 eggs per nest, on average 4.56 eggs. A statistically significant positive correlation was found between mean egg volume and egg breadth, as well as length, egg length and egg shape index, egg length and egg breadth; whereas a statistically significant negative correlation was observed between egg breadth and egg shape index. The laying order did not affect egg dimensions (length, breadth, volume, shape index, all $p>0.05$). The %D-value is 2.31.

Key words: barn swallow, *Hirundo rustica*, position of nest, egg characteristics, laying order, NW Croatia

Dolenec, Z.: Obilježja gniježđenja lastavice (*Hirundo rustica*) na području sjeverozapadne Hrvatske. Nat. Croat., Vol. 11, No. 4., 439–445, 2002, Zagreb.

Istraživanja su obavljena na području sela Mokrice (46°00'N, 15°55'E) na sjeverozapadnom dijelu Hrvatske u razdoblju od 1998. do 1999. godine. Prosječna duljina jaja lastavice iznosi 19.16 mm, širina 13.72 mm, volumen 1840.8 mm^3, indeks oblika jaja 1.40 te masa jaja 1.81 g (u obje godine istraživanja). Gnijezda su smještena na visini 1.5 do 4.5 m (prosjek 2.5 m). U gnijezdima prvog pologa nalazi se 2 do 7 jaja (prosjek 4.56 po gnijezdu). Statistički su značajne pozitivne korelacije između volumena i širine jaja, volumena i dužine jaja, dužine jaja i indeksa oblika jaja, dužine i širine kao i negativna korelacija između širine i indeksa oblika jaja. Nije bilo statistički značajne korelacije između redoslijeda nesenja jaja i dimenzija jaja (dužina, širina, volumen, indeks oblika jaja). Vrijednost %D iznosi 2.31.

Ključne riječi: lastavica, *Hirundo rustica*, položaj gnijezda, obilježja jaja, redoslijed nesenja jaja, sjeverozapadna Hrvatska

INTRODUCTION

The size, length, breadth and shape of eggs are important life-history variables in birds as hatching mass is highly correlated with egg size for a large number of bird species (e.g. COULSON, 1969; PARSONS, 1970; HOWE, 1976; WILLIAMS & BURGER, 1979; HEGYI, 1996). In birds, clutch size and egg size vary with laying date (e.g. HILL, 1984), female age (e.g. DESROCHERS & MAGRATH, 1993), year (e.g. PERRINS, 1969), seasonal variations (e.g. COULSON, 1963), laying order (e.g. MURPHY, 1994), food availability (e.g. BOEKELHEIDE & AINLEY, 1989), female condition (e.g. HORAK *et al*., 1995), heritage (e.g. NOORDWIJK *et al*., 1980), and other factors.

This study has several tasks. First, to present the breeding characteristics of barn swallows (these are the first data from Croatia) and to compare them with data from other countries. Second, to investigate the influence of laying order on egg volume. For example, egg size increases with the laying order in some birds (e.g. HAFTORN, 1986; ENEMAR & ARHEMER, 1999), but it decreases in others (e.g. BANCROFT, 1984; ROFSTAD & SANDVIK, 1985), whereas in some species the laying order has no influence at all on egg volume (e.g. GREIG-SMITH *et al*., 1988).

According to SLAGSVOLD *et al*. (1984), the last egg in the clutch is of special importance. Birds that lay a relatively big final egg adopt the brood – survival strategy whereas birds that lay a relatively small final egg apply the brood – reduction strategy. In many species of altricial birds, eggs hatch asynchronously and the last nestling to hatch may starve to death or be killed by its older and larger siblings. Parents could enhance size hierarchies by laying a smaller egg as the last one in the clutch, or reduce size hierarchies by laying a large last egg, so it has been suggested that intraclutch variation in egg mass influences the establishment of hatching hierarchies (MAGRATH, 1992).

MATERIALS AND METHODS

The research was carried out in the village (250 houses and more than 400 other buildings) of Mokrice (46°00'N; 15°55'E), a part of the Hrvatsko Zagorje area (NW Croatia). 118 clutches (538 eggs) were studied in 1998 and 137 clutches (626 eggs) in 1999, total 255 clutches (1164 eggs). All eggs were measured to the nearest 0.01 mm with sliding calipers. Using a precise Tehnica scale the masses of 100 random selected, fresh eggs were determined to the nearest 0.01 g.

30 nests were visited daily in order to determine laying order and all the eggs laid were marked with a felt pen. 16 nests with the same number of eggs (5 eggs) were used in order to determine the influence of laying order on egg size. In these nests, the laying started on the same day (April 29th 1999). This method was taken from BANBURA & ZIELINSKI (1995). The advantage of this method is that it decreases the number of unwanted internal and external factors in the egg laying period.

To calculate egg volume, I used the formula of HOYT'S (1979): $V = 0.51 \times L \times B^2$. Egg shape index (ES) was calculated using the formula ES = LENGTH / BREADTH (SCHÖNWETTER, 1967–1979). The value of %D can be obtained by calculating the

percentage of final egg volume in relationship to the mean egg volume of the whole clutch. The value of %D was calculated following the instructions by SLAGSVOLD *et al.* (1984) as used by other authors (e.g. MURPHY *et al.*, 1994; DOLENEC, 2001).

According to VAURIE (1959) the birds of my study area belong to the subspecies *Hirundo rustica rustica*.

RESULTS AND DISCUSSION

The nests were situated at a height of 1.5–4.5 m above ground (mean = 2.5m). MCGINN & CLARK (1978) found the majority of nests (41%) at 3–4.5 m above the ground. The position of the nests depended on the height of the buildings in the farms where swallows built their nests. I found 2–7 eggs in a nest, 2 eggs were found in 2 (0.8%) nests, 3 in 15 (5.8%), 4 in 94 (36.8%), 5 in 127 (49.8%), 6 in 16 (6.4%) and 7 eggs in 1 (0.4%) nest. Similar clutch sizes were found in other parts of Europe. SNOW & PERRINS (1998) mention clutch sizes of 4–5 (2–7) eggs, PERRINS (1987) 4–6, and NIETHAMMER (1937) 4–5 eggs. The average clutch size was 4.56. BESSER (1974) states a clutch size of 4.43 (first and second clutch) and BANBURA & ZIELINSKI (2000) 4.66 (first and second clutch). There is a considerable similarity between the mean values of the clutch size in this study (4.56 eggs) and the data by LÖHRL & GUTSCHER (1978) given for Germany, 4.57. In this study, the modal clutch size was 5 eggs (49.8%). ADAMS (1957) gives similar data for Great Britain, where 5-egg clutches were represented in 43% of cases.

Tab. 1. Egg dimensions of the barn swallow in Mokrice village in 1998–1999. SD = standard deviation, CV = coefficient of variation, n = number of eggs (first, second and to somewhat less extent third clutch)

	Mean	Range	SD	CV	n
Length, mm	19.16	16.92–22.04	0.72	3.75	1164
Breadth, mm	13.72	12.11–14.71	0.46	3.35	1164
Volume, mm^3	1840.8	1385.6–2202.3	168.27	8.05	1164
Egg shape index	1.40	1.28–1.51	0.05	3.57	1164
Weight, g	1.81	1.39–2.45	0.14	7.73	100

Tab. 2. Pearson's correlation coefficients (2-tailed) between egg dimensions of the barn swallow in Mokrice village in 1999. Only first clutches included. 5-egg clutches (n = 80 individual eggs). Statistical significance: ***p<0.001

Variable	Egg breadth	Egg volume	Egg shape index
Egg length	0.50***	0.70***	0.51***
Egg breadth	–	0.94***	–0.42***
Egg volume	–	–	–0.10

Egg length averaged 19.16 mm (SD = 0.72), egg breadth 13.72 mm (SD = 0.46), egg volume 1840.8 mm^3 (SD = 168.27) egg weight 1.81 g and egg shape index 1.40 (SD = 0.05) (Tab. 1). The results of this study agree with those of many others, which (HORAK *et al.*, 1995) have shown that egg length is more variable than breadth. CRAMP *et al.* (1988) gives an egg length of 19.7 mm and egg breadth 13.6 mm, VERHEYEN (1967) 20.2 × 13.7 mm and NIETHAMMER (1937) 19.5 × 13.3 mm. If we test correlations of different egg dimensions (Tab. 2), we can see that the strongest posi-

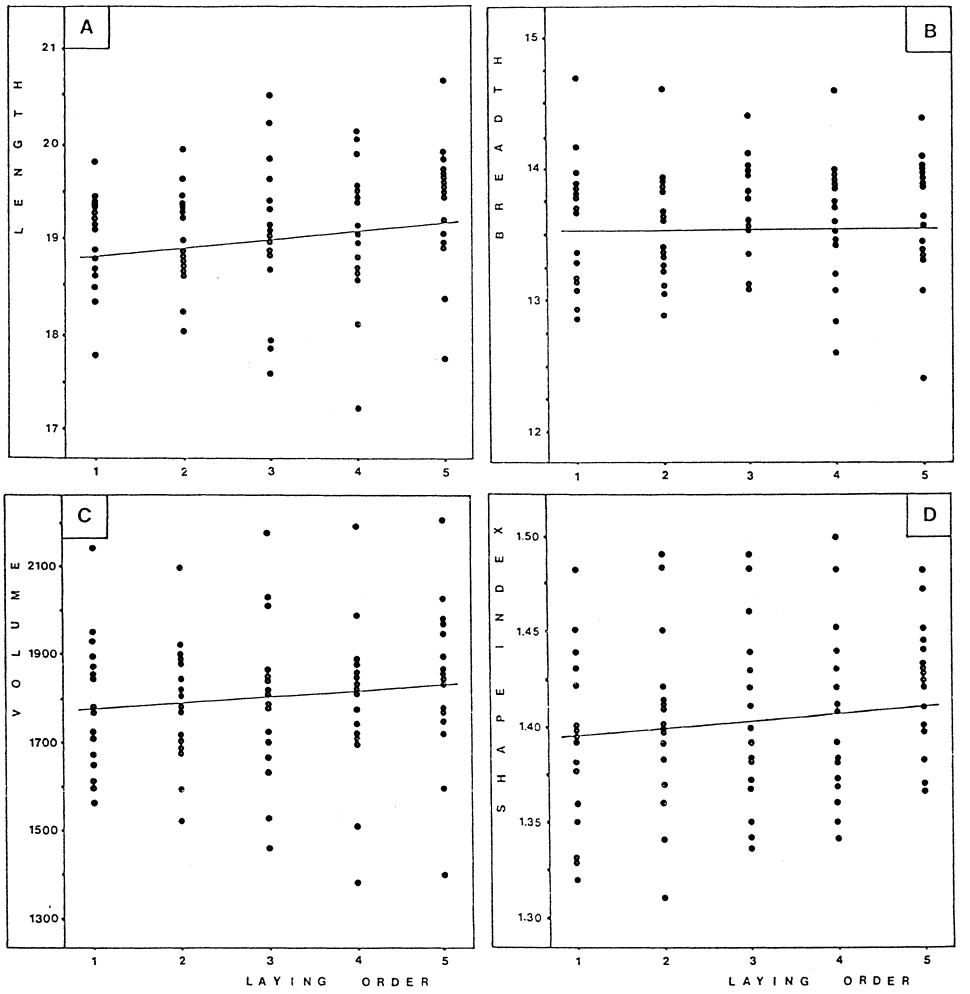

Fig. 1. Pearson's correlation coefficients for various egg dimensions in relation to the laying order of the barn swallow in Mokrice village in 1999. Only first clutches included. 5-egg clutches (n=80 individual eggs). The lines are fitted linear regressions; none are significant ($p>0.05$).

tive correlation exists between egg breadth and egg volume. All other correlations are also statistically significant, except the correlation between egg volume and egg shape index. A strong but negative correlation between egg breadth and egg shape index was also registered.

Fig. 1 gives the correlation between egg dimensions and egg laying order. There was no significant correlation between any egg dimension and laying order, which applies to all nests. However, it is important to stress that the correlation between egg length and the laying order is very close to significance. If we analyse the laying order and egg dimensions for each nest separately, we can observe non-homogeneity. In some nests the dimensions increase, in others they decrease (rarely statistically significant). There were 3 negative correlations and 13 positive correlations recorded between egg length and the laying order (only one was significant). For egg breadth there were 6 negative and 10 positive correlations (only one was significant). For egg volume there were 4 negative and 12 positive correlations (there were 4 statistically significant correlations, 1 negative and 3 positive). There were 6 negative and 10 positive correlations for egg shape index and laying order (not one was significant). Generally (all clutches), laying order did not affect egg dimensions (Fig. 1).

In some bird species, there was a significant correlation between egg dimensions and the laying order within a particular nest. Egg length, breadth and volume all increase significantly with the laying order in the species goldcrest (*Regulus regulus*) (HAFTORN, 1986). The data presented in this study do not allow for the making of any general conclusion that the barn swallow adopts either the brood-survival strategy or the brood reduction strategy. However, the amount of the value of %D (%D = 2.31), and SLAGSVOLD's (1984) opinion lead to the opinion that swallows do apply the survival strategy. According to SLAGSVOLD *et al*. (1984), a large size of the final egg compared to the clutch mean gives the last hatchling better chances for survival.

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SAŽETAK

Obilježja gniježđenja lastavice (*Hirundo rustica*) na području sjeverozapadne Hrvatske

Z. Dolenec

Na području sela Mokrice (Hrvatsko zagorje) istraživana su neka obilježja gniježđenja populacije vrste lastavica. Lastavice gnijezde na tramovima (nosačima) stropa u nastambama za držanje domaćih životinja. Rezultati ovih istraživanja nisu potvrdili niti jednu od poznatih strategija u ptica tijekom razmnožavanja (pogledati primjerice HOWE, 1976), a odnose se na povezanost između veličine jaja (masa ili volumen) i redoslijeda nesenja jaja. Prema %D-vrijednosti (pogledati SLAGSVOLD *et al.*, 1984), lastavica na području sjeverozapadne Hrvatske vjerojatno primjenjuje strategiju »preživljavanja« legla.