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## CLUTCH SIZE, EGG DIMENSIONS AND BREEDING STRATEGY IN THE NUTHATCH *Sitta europaea*

*Veličina pologa, dimenzije jaja i strategija gniježđenja brgljeza *Sitta europaea**

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### ABSTRACT

This study presents clutch size, egg-characteristics and within-clutch egg dimensions variation in Nuthatch *Sitta europaea* in deciduous forests (Hrvatsko zagorje area; NW Croatia). Study comprised the period from 2000 to 2002. Clutch size were 5–8 eggs (mean = 6.63, modal = 7 eggs). Egg length averaged 19,79 mm, egg breadth 14.42 mm, egg volume 2099.66 mm<sup>3</sup> and egg shape index 1,37 (during tree years). Generally, the laying order did not affect egg dimensions (all egg dimensions =  $p > 0.05$ ). According to the value of %D (= -3.11), Nuthatch follows the “brood-reduction strategy”.

### INTRODUCTION

The Nuthatch *Sitta europaea* is a sedentary, strongly territorial hole-nesting species (PAGENKOPF & WESEŁOWSKI 2002), in which pair stays together all the year-round and for several years (e.g. MATTHYSEN 1989, WESEŁOWSKI & STAWARCZYK 1991). Juvenile birds establish territories within weeks of fledging (MATTHYSEN 1987). The question was whether Nuthatches increased egg size in laying order or decreased egg size (in this paper egg volume is used as measure of egg size). According to BAŃBURA & ZIELIŃSKI (1995) different internal and external factors can obscure a potential pattern of variation in egg size in relation to the laying order. This study has several tasks. First, to present the clutch size and egg dimension of Nuthatch (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 size in Nuthatch.

## MATERIAL AND METHODS

The study was conducted during the breeding seasons 2000–2002 in deciduous forest of Common Oak *Quercus robur* and Hornbeam *Carpinus betulus* in Hrvatsko zagorje area, NW Croatia. Other tree species present in low proportion are Common Maple *Acer campestre*, Ash *Fraxinus angustifolia* and Common Elm *Ulmus minor*. The position of the study area is approximately 45°56' – 46°12'N, 15°45' – 16°05'E.

The influence of laying order on egg size was analysed only on clutches with 7 eggs (the modal clutch volume). Only clutches from pairs that bred in nest-boxes were analysed. The internal dimensions of boxes were 120 × 120 × 250 mm. The entrance hole for birds was 32 – 34 mm. The Nuthatch rears only one brood a year.

In 2002, each egg was numbered with a felt-typed, waterproof marking pen on the day it was laid, to establish its laying sequence. All eggs were measured to the nearest 0.01 mm (maximum length and maximum breadth). The egg volume (EV) was calculated according to HOYT (1979), egg shape index (ES) according to SCHÖNWETTER (1967 – 1979), and %D-value according to SLAGSVOLD et al. (1984) – for detailed explanation see DOLENEC (2002a).

## RESULTS AND DISCUSSION

### A) Clutch size and egg-characteristics

During the research period of three breeding seasons 5–8 eggs per nest were recorded: 5 eggs (Figure 1) were found in 8.8%, 6 in 35.1%, 7 in 43.8% and 8 eggs in 12.3% nests (Table 1). The average clutch size was 6.63 eggs (modal = 7 eggs). GLUTZ VON BLOTZHEIM (1962) states a clutch size of 6.53 eggs. According to NIETHAMMER (1937) most nests contained 6–8, rarely 9 eggs. DURANGO (1973) gives clutch size of 6–9, and PERRINS (1987) 5–8, eggs. Egg length averaged 19.78 mm, egg breadth 13.45 mm, egg volume 2099.66 mm<sup>3</sup>, egg shape index 1.37 and weight 1.99 g (Table 2). The between-clutch coefficient of variation (CV) was 3.99% for egg length, 2.91% for egg breadth, 7.78% for egg volume, 3.65% for egg shape index, and 9.01% for egg weight. There are no large differences between egg dimensions in my studies and the figures given for other European countries. For example, egg length in Britain averages 19.20 mm and egg breadth 14.32 mm, and in Netherlands it is 19.8 mm and 14.4 mm (VERHEYEN 1967).

**Table 1.** Clutch size of the Nuthatch in Hrvatsko zagorje during 2000 – 2002 (57 clutches, 376 eggs).

**Tablica 1.** Veličina pologa vrste brgljez na području Hrvatskog zagorja u razdoblju od 2000. do 2002. (57 gnijezda, 376 jaja).

Clutch size	5	6	7	8
n (nest)	5	20	25	7
%	8.8	35.1	43.8	12.3

**B) Egg dimensions variation in relation to the laying order**

In some birds species egg size increases with the laying sequence (e.g. HAFTORN 1986), but it decreases in others (e.g. HEEB 1994), whereas in some species it has no influence on egg volume (e.g. DOLENEC 2002a, 2002b).

On the average, the fourth eggs were the biggest, while the smallest were the last eggs laid (Figure 2). The laying order had no effect on egg dimensions (Pearson's correlation coefficient: length,  $r = 0.066$ ,  $p = 0.580$ ; breadth,  $r = 0.024$ ,  $p = 0.855$ ; volume,  $r = 0.079$ ,  $p = 0.515$ ; egg shape index,  $r = 0.091$ ,  $p = 0.454$ ;  $n = 70$ ). However, on the basis of the %D – value (–3.11), according to SLAGSVOLD et al. (1984), the Nuthatch can be classified as the species that use the “brood-reduction strategy” during the periods of food shortage. A relatively large last-laid egg or small first-laid egg will increase the hatching asynchrony, while a small last-laid egg or large first-laid egg will reduce it (MAGRATH 1992).

**Table 2.** Egg-characteristics of the Nuthatch sampled in Hrvatsko Zagorje in 2000 – 2002 (SD = standard deviation, n = number of eggs).

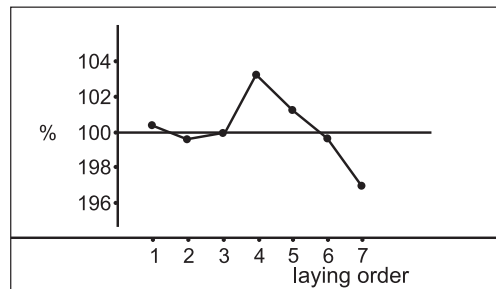
**Tablica 2.** Obilježja jaja brgljeza na području Hrvatskog zagorja u razdoblju od 2000. do 2002. godine (SD = standardna devijacija, n = broj jaja).

Variable	Mean	SD	Range	n
Length, mm	19.79	0.67	18.46 – 22.09	356
Breadth, mm	14.42	0.42	13.41 – 15.98	356
Volume, mm <sup>3</sup>	2099.66	163.37	1870.02 – 2548.11	356
Shape index	1.37	0.05	1.29 – 1.46	356
Weight, g	1.99	0.18	1.89 – 2.18	50



**Figure 1.** A nest with five eggs, photographed in Hrvatsko Zagorje 15<sup>th</sup> April 2000 (Photo Z. DOLENEC).

**Slika 1.** Gnijezdo brgljeza s pet jaja; 15. travanj 2000. godine (snimio Z. DOLENEC).



**Figure 2.** Diagram showing the increase and decrease of the mean egg volume with the position in the laying order. Volumes are expressed as percentages of the clutch's mean volume (clutch size = 7, number of clutches = 10).

*Slika 2.* Dijagram porasta i pada prosječnog volumena jaja s obzirom na redosljed nese-nja. Volumeni jaja su prikazani kao postoci u odnosu na prosjek pologa (broj jaja u gnijezdu = 7, broj gnijezda = 10).

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## SAŽETAK

Na području Hrvatskog zagorja obavljena su istraživanja nekih obilježja gniježđenja vrste brgljez *Sitta europaea* u razdoblju od 2000. do 2002. godine. Istraživanje je bilo usmjereno na veličinu pologa, dimenzije jaja i strategiju gniježđenja. Prema SLAGSVOLDU i sur. (1984) ptice tijekom razmnožavanja primjenjuju “strategiju preživljavanja legla” (jaja su sve veća redosljedom nesenja, a posljednje sneseno jaje veće je od prosjeka pologa) ili “strategiju redukcije legla” (jaja su sve manja redosljedom nesenja, a posljednje sneseno jaje iste je veličine ili manje od prosjeka pologa). Volumen jaja brgljeza nije se statistički značajno mijenjao redosljedom nesenja (Pearsonov koeficijent korelacije,  $p > 0,05$ ), pa dobiveni rezultati ne podržavaju niti jednu od spomenutih strategija. Ipak, posljednja snesena jaja su prosječno manja od prosjeka pologa (%D = -3,11), što znači da vrsta brgljez vjerojatno primjenjuje “strategiju redukcije legla” tijekom razmnožavanja. O strategijama gniježđenja detaljnije pogledati primjere u djela: SLAGSVOLD i sur. 1984, MAGRATH 1992, HEEB 1994 i drugu literaturu.