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REPRODUCTIVE STRATEGY OF THE SONG THRUSH *Turdus philomelos* IN RELATION TO EGG DIMENSION

Strategija razmnožavanja drozda cikelja Turdus philomelos u odnosu na dimenzije jaja

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ABSTRACT

This paper presents egg-characteristics (only first clutches with five eggs included) and the deviation of the final egg from mean referred here as %D-value in Song Thrush *Turdus philomelos* in deciduous forests, parks and traditional orchards in northwestern Croatia. Study comprised the period from 2021 to 2024. Egg length averaged 27.74 (±1.33) mm, egg breadth 20.51(±0.76) mm, egg volume 5856.85 (±528.41) mm^3 and egg shape (elongation) index 1.38 (±0.05). According to the value of %D = 5.6, the Song Thrush adopted a "brood survival strategy" to ensure that more offspring could survive. The results presented in this paper contain first oological data reported on Song Thrush in Croatia.

Keywords: songbird, brood survival strategy, NW Croatia

INTRODUCTION

Egg dimensions are generally held to be important indices of egg quality, and egg dimensions may be positively correlated with hatchling size, condition, nestling growth rate and survival in many bird species (e.g. Schifferli 1973, Risch & Rohwer 2000, Krist 2011). In birds, egg dimensions vary with pre-breeding body condition of female (e.g. Christensen & Balsby 2020), year-to-year differences (e.g. Adamou *et al.* 2018), female age (e.g. Verhoeven *et al.* 2020), laying sequence (Song *et al.* 2016), laying date (e.g. Hill 1984), seasonal change (e.g. Du *et al.* 2012), different habitat (Järvinen 2020), climate change (e.g. Skwarska *et al.* 2015), etc. This study has two goals. First, to present data on the egg characteristics of the Song Thrush *Turdus philomelos*, collected in northwestern Croatia, and

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second, to calculate the deviation of the final egg from clutch mean referred here as %D-value (according to Slagsvold *et al.* 1984). According to this author, birds that lay a relatively small final egg apply the "brood reduction strategy" whereas birds that lay a relatively large final egg adopt the "brood survival strategy". According to Hargitai *et al.* (2005), females can vary egg size investment through a combination of external and internal factors.

In this paper, I demonstrate the relationship between the last laid egg and the average of all eggs in the nest, as well as the general characteristics of egg dimensions (only first clutches with five eggs included). Research species is monogamous, open-nesting and migratory bird species (Cramp 1998). The results presented in this paper contain first oological data reported on Song Thrush in Croatia.

MATERIAL AND METHODS

The study was conducted in a mosaic area within the small natural deciduous forest (dominated by the pedunculate oak *Quercus robur* and European hornbeam *Carpinus betulus*) in northwestern Croatia (Mokrice and Krušljevo Selo area; 45°58'– 46°00'N, 15°51'–15°54'E). Study comprised the period from 2021 to 2024 (month of April). Nest-sites were mostly in trees, bushes and hedgerows. Gardens also played an important role during nesting. In this study only first clutches were included with five eggs (the modal clutch size of the first clutch; unpublished data). The modal clutch size was also used in previous papers (e.g. Howe 1976, Dolenec 2004). A total of 28 nests were analysed. Nests were visited daily during study period. Eggs were marked with pens. I stayed near the nest for as little time as possible and was careful not to leave visible traces. Only eggs from completed clutches were used to characterise egg dimensions and egg shape. All eggs were measured with callipers to the nearest 0.01 mm (maximum length and breadth). I estimated egg volume (V) based on maximum egg length (L) and maximum breadth (B), using the formula V = 0.51 (constant) x L x B^2 (Hoyt 1979). This method was used previously in many researches (e.g. Enemar 1997, Zhao & Sun 2018) and also by author of this study (e.g. Dolenec 1994, 2020, 2023). The egg shape (elongation index, EI) was calculated by dividing egg length (L) by egg breadth (B) (EI = L/B) (see Schönwetter 1967–1979, Hoyt 1976). This formula was also used in other ornithological works (e.g. Dolenec 2006, Skwarska *et al*. 2015). The relative size of the final egg laid (%D) was calculated according to Slagsvold *et al.* (1984) as the percentage deviation from the mean egg size of all the eggs in the clutch [%D = (VF – VM)100%/VM in which VF = volume of the final egg and VM = mean egg volume of the clutch]. This method was used, for example, by Järvinen & Ylimaunu (1986), and also by the author of this study (e.g. Dolenec 2002).

RESULTS AND DISCUSSION

A total of 140 Song Thrush eggs from 28 clutches were used in the analysis (only first clutches with five eggs were included). Egg length averaged 27.74 (±1.33) mm, egg breadth 20.51(±0.76) mm, egg volume 5856.85 (±528.41) mm^3 and egg shape (elongation) index 1.38 (±0.05). Egg dimension values and egg shape of the Song Thrush in this study are similar to the results collected in other European countries (e.g. Enemar & Arheimer 1999, Frachuk 2013).

According to Slagsvold *et al*. (1984), birds which lay relatively larger final eggs are adopting the "brood survival strategy" (the last nesting is capable of rivalry with its older siblings), whereas birds which lay relatively small final eggs are adjusting to the "brood reduction strategy" (the last nestling will be sacrificed in the event of food shortage). The value in this study of %D is 5.8. The Song Thrush breeding in my study area seem to have adopted the "brood survival strategy" since the last egg is larger than the nest average. Therefore, the last hatched nestling will be in equal competition with the other siblings (ensured that more offspring can survive). Similarly, in the Grey-backed Shrikes *Lanius tephronotus* (Fan *et al.* 2021) the last offspring in the brood is disadvantageous in the size hierarchy because it hatches later. However, the last bird is laid from the largest egg. Therefore, he is in an equal position with the rest of his siblings. Hillström (1999) has a similar opinion regarding the Pied Flycatcher *Ficedula hypoleuca*. The Pied Flycatchers appear to use a 'brood survival strategy'; that is, they lay a large last egg, which contains more nutrients, to compensate for the late hatching of the last egg. Generally, further investigation is needed to fully understand this phenomenon.

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SAŽETAK

Istraživanje je provedeno na području Mokrica i Krušljevog sela i to najvećim dijelom u manjim šumama, tradicionalnim voćnjacima te u parku (sjeverozapadna Hrvatska). Podaci su prikupljani četiri godine (2021. – 2024.) ekstenzivnim pristupom. Cilj je bio sakupiti podatke o dimenzijama jaja s posebnim naglaskom na posljednje snešeno jaja kako bi se utvrdilo koju strategiju tijekom razmnožavanja primjenjuje drozd cikelj *Turdus philomelos.* Analizirana su samo jaja prvog gniježđenja sa pet jaja iz razloga što je kod različite brojnosti jaja u gnijezdu i različit utrošak energije. Ukupno je analizirano 28 gnijezda. Na temelju izračunate %D-vrijednosti (postotak veličine posljednje snesenog jajeta u odnosu na srednju vrijednost gnijezda) koja iznosi 5,6, rezultat sugerira, da drozd cikelj primjenjuje „strategiju preživljavanja potomstva" budući da će posljednji izvaljani čučavac biti zbog svoje veličine u ravnopravnom odnosu s ostalom braćom iako će se izvaljati dan kasnije (asinkrono valjanje).