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REPEATABILITY OF CLUTCH SIZE IN FEMALE STARLINGS (*STURNUS VULGARIS*)

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Here I report on repeatability of clutch size. This study was carried out during the breeding season (first and second clutches) of 2003 in the village Mokrice (46°00′N, 15°55′E; NW Croatia). Repeatability of clutch size in first and second clutches (within-year) of female starlings was low and not significant.

Key words: starling, *Sturnus vulgaris*, clutch size, repeatability

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U ovome su radu prikazani rezultati istraživanja ponovljivosti veličine pologa unutar jedne godine (prvi i drugi polog) u ženke čvorka. Uzorkovanje je obavljeno u razdoblju gniježđenja 2003. godine na području sela Mokrice (46°00′N, 15°55′E; sjeverozapadna Hrvatska). Ponovljivost veličina pologa je niska i nije statistički značajna.

Ključne riječi: čvorak, *Sturnus vulgaris*, veličina pologa, ponovljivost

INTRODUCTION

Theories of clutch size determination have focused on first broods or on seasonal trends in clutch size. Clutch size is controlled by combination of genetic, ontological and environmental factors (KENNEDY & WHITE, 1991). In recent years, an increasing number of studies have demonstrated the existence of significant repeatability in ecologically important traits in natural bird populations (e.g. GOODBURN, 1991; JERZAK *et al*., 2000; AMAT *et al*., 2001; YOSEF & ZDUNIAK, 2004). Repeatability expresses the proportion of the variation between measurements that is due to consistent differences between the objects measured (HÕRAK *et al*., 1995). According to van NOORDWIJK *et al*. (1980), no single optimum value exists for clutch size. In some years small clutches are optimal, in other years large clutches contribute more to

Fig. 1. Ringed starling female (Photo Z. Dolenec)

the next generation. The variation probably mirrors the range of values that are at some moment or at some place more productive than others.

The aim of this study is to show the effect of environmental factors on egg number using repeatability estimates.

STUDY AREA AND METHODS

This study took place in the village Mokrice (46°00′ W, 15°55′ E), in NW Croatia. My studies comprise the period from March to July 2003. The birds bred in nest boxes placed at a height of about 2.5–5 m. The dimensions of the nest-box were approximately 16x16x25 cm, the diameter of the entrance hole being 4.5–5.0 cm. The study included first and second clutches. Nest-boxes were checked regularly to determine clutch size. Analyses are conducted only on females; the same female on the same territory. I ringed adult females with numbered metal rings (Fig. 1). Clutch

size was assigned when the same number of eggs was recorded on two consecutive visits to the nest. In this study population, starlings usually produce two regular broods per year (DOLENEC, 1997). Repeatability is a measure used in quantitative genetics to describe the proportion of variance in a character that occurs among rather than within individuals (LESSELLS & BOAG, 1987). Repeatability, r, is given by:

$$r = (V_G + V_{Eg})/ V_P,$$

where V_G is the genotypic variance, V_{Eg} the general environmental variance, and V_P the phenotypic variance (FALCONER, 1981). Repeatability (or intra-class correlation coefficients) can also be calculated using the among-group variance component (s^2_A) and the within-group variance (s^2), derived from one-way analysis of variance (ANOVA, see SOKAL & ROHLF, 1981; LESSELLS & BOAG, 1987):

$$r = s^2_A/ (s^2 + s^2_A)$$

These variance components are calculated from the mean squares in the analysis of variance as:

$$s^2 = MS_W$$

and

$$s^2_A = (MS_A - MS_W) / n_0,$$

where n_0 is a coefficient related to the sample size per group in the analysis of variance. The value of n_0 is calculated as:

$$n_0 = 1 / (a-1) [\Sigma n_i - (\Sigma n_i^2 / \Sigma n_i)],$$

where a is the number of groups and n_i is the sample size in the ith group.

Standard errors of the repeatability estimates were calculated following BECKER (1984). Statistical analyses were performed using the SPSS 12.0 statistical package.

P-values higher than 0.05 were considered non-significant.

RESULTS AND DISCUSSION

Clutch size characteristics of starlings in the present study site are presented in Tab 1. The repeatability of clutch size in first and second clutches of female star-

Tab. 1. Average clutch size in a single breeding season in starlings (same females and same territory) in 2003 (SD = standard deviation)

	First clutch			Second clutch		
Parameter	Mean	SD	N	Mean	SD	N
Clutch size	5.83	0.72	12	5.00	0.74	12

Tab. 2. Within-year repeatability of clutch size in individual female starlings in 2003 (r = repeatability; SE = standard error; s^2 = within-female variance; s^2_A = among-females variance)

Parameter	s^2	s^2_A	r (SE)	n_0	F	df	p
Clutch size	0.583	0.11	0.16 (0.11)	2.00	1.377	11;12	0.295

lings in 2003 was low (r = 0.16) and not significant (ANOVA, $F_{11,12} = 1.377$, $P > 0.05$; Tab. 2). This suggests that most of the variation in clutch size was due to intra-individual variation in response to environmental conditions. Females in the house wren (*Troglodytes aedon*) showed relatively low but significant consistency in their clutch sizes across broods (KENNEDY & WHITE, 1991). Similarly, relatively low repeatability of clutch size has been reported by other authors (e.g. MURPHY, 1978). In some bird species we can also see different results. In the magpie (*Pica pica*), repeatability was highly significant for clutch size of a subsequent breeding attempt within a single season when the first breeding attempt had failed (GOODBURN, 1991).

Unfortunately, the genetic component of variation is inseparable from that resulting from general environmental effects; because of this the value of repeatability may be treated only as a first indication of genetic variation, or an upper limit of corresponding (unknown) heritability (BAÑBURA & ZIELIŃSKI, 1990).

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SAŽETAK

Ponovljivost veličine pologa u ženki čvoraka (*Sturnus vulgaris*)

Z. Dolenec

U kvantitativnoj genetici ponovljivost daje gornju granicu stupnja genetičke određenosti pojedinog obilježja. Iz rezultata istraživanja proizlazi niska ponovljivost veličine drugog pologa u odnosu na prvi ($r = 0.16$; iste ženke na istom teritoriju) i statistički nije značajna (ANOVA, $p > 0.05$). Niska ponovljivost veličine pologa sugerira veći utjecaj čimbenika staništa (»territory quality«) u odnosu na utjecaj ženke (»female quality«). Istraživanja ponovljivosti dimenzija jaja istih ženki dala su suprotne rezultate – značajniji utjecaj ženki (DOLENEC, 2005).