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Older Males of Common Rosefinch *Erythrina erythrina* (Pallas, 1770) (Aves: Passeriformes) Sing Longer Strophes than Younger Individuals

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Abstract: In males of many bird species, plumage coloration and song characteristics can change with age. In the common rosefinch *Erythrina erythrina* delayed plumage maturation is observed, young males are duller than older ones and are similar to females. To date, variation in song parameters at a microgeographic scale and between various populations from Europe and Asia have been documented but characteristics of males' songs at different ages have not been studied. We studied whether the difference in plumage between subadult and adult males was correlated with differential song structure. Parameters of the songs of yearling and older males were generally similar but we showed that certain song characteristics varied between the two age classes, with older males singing with a longer strophe length than yearlings. The song and plumage coloration may play different roles in mate choice in this species.

Key words: age classes, bird song, plumage coloration, song parameters

Introduction

Age-dependent traits in birds appear to be a widespread phenomenon. They can affect the probability of acquiring a mate, timing of reproduction, success in obtaining extra-pair fertilisations or survival (Martin 1995, Cucco & Malacarne 2000, Nowicki & Searcy 2004, Mitrus et al. 2014). Special attention has been paid to the marked difference in plumage coloration between young and adult males in passerines and many hypotheses have been proposed as explanations of this phenomenon (Rohwer et al. 1980, Hill 1989, Weggler 1997, Cucco & Malacarne 2000). Females can relatively easy use visual signals to assess the status of a male. Other potential traits differentiating both groups of males can include song characteristics. Many studies indicate that song characteristics are not only related to individual fitness but also to male age (Garamszegi et al. 2005, Poesel et al. 2006, Nemeth et al. 2012). Male song characteristics of two age groups may differ significantly, while in species without a delay in plumage maturation, there are only small, if any, differences in song between age classes (Cucco & Malacarne 1999).

In the common rosefinch *Erythrina erythrina* (Pallas, 1770), males are characterised by variability in plumage coloration. Birds in their second year have greyish-green heads and chests and in this plumage coloration are similar to females, whereas in older males, these parts of the plumage have a carmine colour (Cramp & Perrins 1994). The song of the common rosefinch is short (ca. one second), including three to nine (usually 3–6) pure-tone el-

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ements in the song (Björklund 1990, Cramp & Perrins 1994). These elements vary slightly and are combined in different ways to produce many different song types (Martens & Kessler 2000). So far, the microgeographic variation in the song parameters have been studied (Björklund 1990) and the characteristics of songs of various populations from Europe and Asia (Martens & Kessler 2000). However, no characteristics of male songs in different age groups were studied. In this study, we examined whether the difference in plumage between subadult and adult males was correlated with differential song structure.

Materials and Methods

The studies were conducted in east-central Poland in the valley of Kostrzyń River (52°10'N, 21°57'E), which belongs to the Natura 2000 site „Dolina Kostrzynia". The study area was about 2000 ha and included wide meadows with small woods consisting mainly of alder *Alnus* sp. and willows *Salix* spp. The common rosefinch is one of the most valuable bird species in this area, breeding in numbers of 114-150 pairs, which comprises 1% of the entire Polish population of this species (Dombrowski et al. 2011).

After arrival, males' songs were recorded using a Marantz PMD620 digital recorder with a microphone Sennheiser ME 66 with capsule K 6/6. Males were recorded between the second half of May and the end of June 2015 during the breeding season. Songs were subsequently analysed using Audacity v. 1.3.9 (http://audacity.sourceforge.net/). The following measures were taken on each male (for definitions see Fig. 1): strophe length (in seconds), number of syllables and the highest and lowest frequencies (in kHz). The statistical analyses included only records at least 60 s in length and with a minimum of 15 strophes. In total, the songs of 45 males were analysed ($N_{yearling}$ = 17 males, N_{older} = 28 males), with an average of 21.4 (SE = 0.66) strophes per male. In the analysis, average values of song parameters for each male were used.

To consider song as a potential indicator of male age, we split our sample into two age classes: yearling males (0) and males older than one year (1). Age was thus analysed as a binary variable by constructing generalised linear models (GLM) with a binomial error structure and logit link function. The continuous predictors were: strophe length, number of syllables in each strophe, lowest and highest frequencies. We used the Akaike's Information Criterion corrected by sample size AICc to select the most parsimonious model. Models were ranked on the basis of the differences between the AICc of a given model and the AICc of the highest ranked model (ΔAICc), and on the basis of a measure of the weight of evidence for a model expressing the probability that that model is actually the best one (AICc weight) (Burnham & Anderson 2002). We show results of analysis with the predictor from the Akaike best model (strophe length, reduced model) and also results of analysis with all predictors (full model). Owing to the fact that correlation between variables was not higher than 0.6 (in all cases), then all of them were incorporated in the model. The values are reported as mean ± 1 SE. Only results with a probability of $\alpha \leq 0.05$ were assumed to be statistically significant. The analyses were performed in the module provided by Statistica 10.0 (StatSoft 2012).

Results

The parameters of the songs of yearling and older males were generally similar. The greatest differences were detected in strophe length and number of syllables, which were higher in older males (Table 1). Song performance characteristics varied between the two age classes: older males sang at a longer strophe length than yearlings. Strophe length as a predictor variable was significant in both the reduced and full GLM models (Table 2), the songs of older males being characterised by longer strophe length than in yearling males. The difference in strophe length was only 20% (0.2 s), but was statistically significant.

Discussion

To the best of our knowledge, our results are the first documented case showing differences in song between two age groups of common rosefinch males (Cucco & Malacarne 2000). In other species, differences in song parameters between yearling and older males have also been documented (Cucco & Malacarne 1999, Kiefer et al. 2006). However, the common rosefinch is capable of reducing differences in the songs of birds of different ages. Males of the common rosefinch can create loose breeding colonies and neighbours can use very similar songs, which are hard to distinguish even when analysed by their sonograms (Martens & Kessler 2000). Singing males newly arrived on the breeding area are capable of changing their song type within a few hours. The new songs become the type commonly used in the local population (Björklund 1989). In contrast, in other species, for example red-winged

blackbirds *Agelaius phoeniceus,* repertoire size increases with age (Yasukawa et al. 1980). Thus in the common rosefinch, the rapid adoption of similar songs may hinder the detection of differences in song parameters between males. Given the relatively small area and population studied in east-central Poland, this phenomenon was probably not so important. However, the song of the common rosefinch is fairly simple and short, consisting usually of 5 syllables (Björklund 1989, Cramp & Perrins 1994), which may hinder the detection of differences.

Despite the differences in plumage coloration between yearling and older males and the differences in song characteristics between the two groups shown in this paper, the roles of these phenomena for females in mate choice are not known. Data about

Table 1. Parameters of song variables in the two age classes of males of common rosefinch *Erythrina erythrina*.

Parameters	Yearling males, n = 17		Older males, n = 28	
	Mean ±SE	Range	Mean ±SE	Range
Strophe length (s)	1.0±0.04	0.73-1.30	1.2±0.04	0.80-1.80
Number of syllables	4.7±0.14	4.0-6.0	5.1±0.14	3.0-7.2
Lowest frequency (kHz)	2.1±0.06	1.5-2.5	2.1±0.05	1.5-2.5
Highest frequency (kHz)	6.4±0.09	5.5-7.0	6.6±0.08	5.5-7.5

Table 2. Song variables that predicted the two age classes of males of common rosefinch *Erythrina erythrina* by GLM analysis (age as binary dependent variable, yearlings vs. older males, $N_{yearling} = 17$, $N_{older} = 28$)

Predictors	Estimate	SE	Wald statistics	P-value
Full model, Akaike weight: 0.027				
Intercept	-6.78	6.42	1.11	0.291
Strophe length	8.06	4.03	4.01	0.045
Number of syllables	-0.88	0.93	0.89	0.344
Lowest frequency	0.34	1.43	0.06	0.812
Highest frequency	0.32	1.03	0.10	0.754
Reduced Model, Akaike weight: 0.283				
Intercept	-5.39	2.57	4.38	0.036
Strophe length	5.42	2.39	5.15	0.023

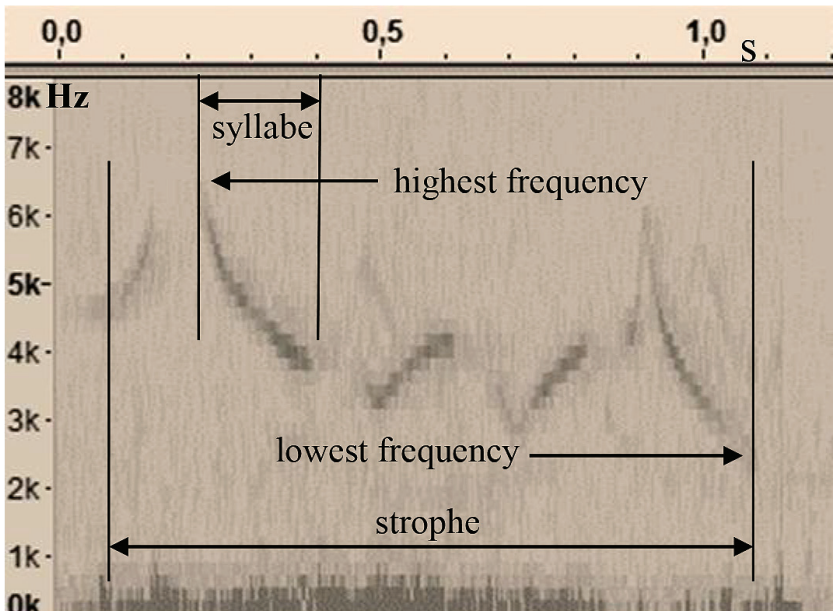

Fig. 1. Definition of song elements used in the song analysis.

females' preferences are contradictory. Björklund (1990) found no relationship between pairing success and male plumage brightness, whereas Zając (2006) suggested that females preferred more intensively coloured older males and that younger males achieved lower mating success. These disparities may indicate that song and plumage coloration can play different roles and females' preferences could depend on the particular social and ecological conditions of a given population and breeding area (Badyaev & Quarnström 2002). For example, in the common yellowthroat *Geothlypis trichas* plumage ornaments predicted within-pair mating success, while song consistency predicted extra-pair success (Taff et al. 2012).

Our results indicated that young males of rosefinch differed from older ones not only in plumage coloration but also in song characteristic. However, these differences were relatively small and concerned only strophe length, which was shorter in young males.

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References

Badyaev A. V. & Quarnstrom A. 2002. Putting sexual traits into the context of an organism: a life-history perspective in studies of sexual selection. Auk 119: 301–310.

Björklund M. 1989. Microgeographic Variation in the Song of the Scarlet Rosefinch *Carpodacus erythrinus*. Ornis Scandinavica 20: 255–264.

Björklund M. 1990. Mate choice is not important for female reproductive success in the Common Rosefinch (*Carpodacus erythrinus*). Auk 107: 35–44.

Burnham K. P. & Anderson D. R. 2002. Model Selection and Multimodel Inference: A Practical Information Theoretical Approach. 2d Edition. New York: Springer.

Cramp C. & Perrins C. M. 1994. Handbook of the Birds of Europe, the Middle East and North Africa. Vol. 8. Oxford: Oxford University Press. 899 p.

Cucco M. & Malacarne G. 1999. Is the song of Black Redstart males an honest signal of status? Condor 101: 689–694.

Cucco M. & Malacarne G. 2000. Delayed maturation in passerine birds: an examination of plumage effects and some indications of a related effects in song. Ethology Ecology & Evolution 12: 291–308.

Dombrowski A., Kot H. & Kot C. 2011. Avifauna of the Kostrzyn River Valley in 2010. Kulon 16: 41–62. (in Polish).

Garamszegi L. Z., Heylen D., Moller A. P., Eens M. & de Lope F. 2005. Age-dependent health status and song characteristics in the barn swallow. Behavioral Ecology 16: 580–591.

Hill G. E. 1989. Late spring arrival and dull nuptial plumage, aggression avoidance by yearling males? Animal Behaviour 37: 665–673.

Kiefer S., Spiess A., Kipper S., Mundry R., Sommer C., Hultsch H. & Todt D. 2006. First-year common nightingales (*Luscinia megarhynchos*) have smaller song-type repertoire size than older males. Ethology 112: 1217–1224.

Martens J. & Kessler P. 2000. Territorial song and song neighbourhoods in the Scarlet Rosefinch *Carpodacus erythrinus*. Journal of Avian Biology 31: 399–411.

Martin K. 1995. Patterns and mechanisms for age-dependent reproduction and survival in birds. American Zoologist 35: 340–348.

Mitrus J., Mitrus C., Rutkowski R. & Sikora M. 2014. Extra-pair paternity in relation to age of the Red-breasted Flycatcher *Ficedula parva* males. Avian Biology Research 7: 111–116.

Nemeth E., Kempenaers B., Matessi G. & Brumm H. 2012. Rock Sparrow Song Reflects Male Age and Reproductive Success. PLoS ONE 7: e43259.

Nowicki S. & Searcy W. A. 2004. Song function and the evolution of female preferences: why birds sing, why brains matter. Annals of New York Academy of Sciences 1016: 704–723.

Poesel A., Kunc H. P., Foerster K., Johnsen A. & Kempenaers B. 2006. Early birds are sexy: male age, dawn song and extra-pair paternity in blue tits, *Cyanistes* (formerly *Parus*) *caeruleus*. Animal Behaviour 72: 531–538.

Rohwer S. & Butcher G. S. 1988. Winter versus summer explanations of delayed plumage maturation in temperate passerine birds. American Naturalist 131: 556–572.

StatSoft. 2012. Statistica (Data Analysis Software System), Version 10.0. Tulusa: StatSoft.

Taff C. C., Steinberger D., Clark C., Belinsky K., Sacks H., Freeman-Gallant C. R., Dunn P. O. & Whittingham L. A. 2012. Multimodal sexual selection in a warbler: plumage and song are related to different fitness components. Animal Behaviour 84: 813–821.

Weggler M. 1997. Age-related reproductive success and the function of delayed plumage maturation in male Black Redstarts *Phoenicurus ochruros*. PhD, University of Zurich, Zurich, Switzerland, 110 p.

Yasukawa K., Blank J. L. & Patterson C. B. 1980. Song repertoires and sexual selection in the Red-winged Blackbird. Behavioral Ecology and Sociobiology 7: 233–238.

Zając K. 2006. Breeding ecology of the Scarlet Common Rosefinch *Carpodacus erythrinus* at Podgorzyn fishponds. Ptaki Śląska 16: 5–16 (in Polish).

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