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SONG REPERTOIRE AND COMPARATIVE ANALYSIS OF SONG STRUCTURE OF CHAFFINCH, *FRINGILLA COELEBS* (FRINGILLIDAE), FROM THE NORTHEAST OF BALKAN REGION

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Song Repertoire and Comparative Analysis of Song Structure of Chaffinch, *Fringilla coelebs* (Fringillidae), from the Northeast of Balkan Region. Tsvelykh A. N., Yablonovska-Grishchenko E. D. —

The repertoire of chaffinches from the northeast of Balkan region consists of 39 song types, 9 of them are most widespread. Comparative analysis of the chaffinch song types from the Balkans and from Caucasus, East Carpathians, Crimean Mountains, plain regions of Ukraine was done. It revealed no Balkan song types in other regions. Chaffinch songs from Balkan are similar by structure to songs from the Caucasus and East Carpathians and quite different from songs from the Crimea and Ukrainian plains. In songs of Balkan chaffinches we discovered 106 elements. Five of them are specific for local birds, 101 were found in birds from other populations. However, 37 elements are common with ones in East Carpathian populations but they were absent in chaffinch songs recorded in the Crimea and plain regions of Ukraine. Common elements in bird songs from the East Carpathians and the Balkans may be an evidence of distant relations between these territorial song complexes and/or presence of relic elements in south mountain complexes. The rain-calls of Balkan chaffinches radically differ from those of birds of Crimea, plain regions of Ukraine and East Carpathians and quite identical to calls of the Caucasus birds.

Key words: Chaffinch, Balkans, song, repertoire, sonogram.

Песенный репертуар и сравнительный анализ структуры песни зябликов *Fringilla coelebs* (Fringillidae) с северо-востока Балканского региона. Цвелых А. Н., Яблоновская-Грищенко Е. Д. —

В репертуаре зябликов с северо-восточной части Балканского региона выявлено 39 типов песен, из которых наиболее распространены 9. Сравнение песен балканских зябликов с песнями птиц с Кавказа, Восточных Карпат, Крыма и равнинной Украины показало полное отсутствие общих типов песен. Структура песен балканских зябликов оказалась сходной со структурой песен птиц Кавказа и Восточных Карпат, но существенно отличалась от структуры песен птиц Крыма и равнинных районов Украины. Из 106 элементов, выявленных в песнях балканских зябликов, 5 — оказались специфичными для местных птиц, ещё 37 — общими с элементами, выявленными исключительно в популяции зябликов Восточных Карпат и отсутствующими в песнях зябликов из Крыма и равнинных районов Украины. Наличие общих элементов в песнях зябликов Балканского региона и Восточных Карпат может свидетельствовать об отдалённых родственных связях между этими территориальными песенными комплексами или (и) о сохранении реликтовых элементов в песнях этих горных популяций. «Дождевые сигналы» зябликов Балкан радикально отличаются от аналогичных сигналов птиц Крыма, равнинной Украины и Восточных Карпат и совершенно идентичны сигналам птиц Кавказа.

Ключевые слова: зяблик, Балканы, песня, репертуар, сонограмма.

Introduction

A chaffinch song is narrowly determined. It always consists of phrases with several analogous elements. Specific terminal element (flourish) is the last element of a song. Phrases sometimes are divided by solitary “inserted” elements. One or more pre-flourish elements are performed before the flourish element in some songs. Such quite simple structure of a song enables to describe song types and to analyze objectively song repertoires of chaffinches from different populations.

A chaffinch song repertoire and song structure in Balkan region has not been studied. It is possible that archaic chaffinch song complexes may still exist there.

Material and methods

A song repertoire of chaffinches was studied in the utmost southeast of Bulgaria, at the wooded seashore side of Strandzha Mountains (10 km width territory between villages of Ahtopol and Resovo) in June 2010. Chaffinch songs were recorded with a digital recorder US 550 PR Panasonic (frequency range: 180–15100 Hz). In all, 1682 songs from 197 males were recorded. Syrinx 5.2s soft (Burt, 1995–2005) was used to analyze records and obtain sonograms.

Song types were determined using the semi-quantitative method of song analysis (Yablonovska-Grishchenko, 2006). Elements of a song sonogram were described with alphanumeric codes. Thus, each song was presented in view of formula compiled of such codes. Songs described with the same formulas were united in separate types (consequently, sonograms of such songs are almost identical). If formulas did not differ significantly, by one or two analogous elements, they were considered as sub-types of one type. However, if a song had a new phrase with full correspondence of all other elements, we assigned a new type. We did not analyze the “kit” element sometimes performed by birds after finishing a song as it is not a specific part of a song.

We distinguish such sound types in elements of Chaffinch song: whistle, trill and harmonic. Whistle is the “single” sound sometimes with rise or fall of tone, but in any point of time only one note is sounding. Trill is a series of frequent wide-spectrum sounds. Harmonic is a compound sound similar to a chord. In any point of time complex of constituents (harmonics, or overtone) is sounding.

Chaffinch songs from the Balkans were compared with songs from other regions. We used original and published sonograms and song formulas from the East Carpathians, the Crimea and the west part of Forest and Forest-Steppe zones of Ukraine (plain part of Ukraine) described by the identical method (Yablonovska-Grishchenko, 2005; Yablonovska-Grishchenko, Grishchenko, 2007, 2008; Tsvelykh, Yablonovska-Grishchenko, 2012). Data on the Caucasian region were taken from publications of Sultanov (1984, 1988, 1991) and Simkin (1983). Data were statistically processed with STATISTICA 5.1, *p*-value calculated by Student’s *t*-test.

Results and discussion

The song repertoire. Thirty nine song types (49 sub-types) were found in the studied Balkan chaffinch population. Nine of them are the most common: they occur in repertoires of different chaffinches most frequently (fig. 1, 1–18). All songs consist of 2–4 phrases. In most song types the inserted elements between phrases are absent. Only a third of the types included one of such elements. Pre-flourishes were found in a third of the types too.

In songs of the Balkan Chaffinches we discovered 106 discrete indivisible elements. Most of them are whistles (70 %). Harmonics and trills are substantially rarer, 19 % and 11 % correspondingly. The first phrase of a song consists mainly of whistles in 44 of 49 (89.8 %) sub-types; we analyzed both types and sub-types in this case. Trill and harmonic elements are not numerous in the first phrase: they are present in 2 (4.1%) and 3 (6.1%) sub-types correspondingly. Other phrases consist almost exclusively of whistle elements. Only second phrase sometimes includes harmonic elements. Inserted elements are represented by whistles (in 9 sub-types, 18.4 %) and trills (in 7 sub-types, 14.3 %). Only one harmonic inserted element was found in one sub-type (2 %). Pre-flourishes are mainly whistles (14 sub-types or 28.6 %), two sub-types (14.1 %) include trill pre-flourishes. We found no harmonic elements in pre-flourishes. But flourishes are predominantly presented by harmonics (29 sub-types, 59.2 %), whistles and trills were found in nearly equal number [11 (22.4 %) and 9 (18.4 %) correspondingly].

We have compared song complex from the Balkans with that one from the East Carpathians, Crimea, Caucasus and plain Ukraine. But we found no common song type between Balkan complex and others. Three Balkan song types were found in song complex of afforestation near Ismail city in the Lower Danube (Yablonovska-Grishchenko et al., 2011). These songs did not registered in other points of the Lower Danube region, and we suppose this case is a visit of some birds of the Balkans northerly from their usual territory.

Comparative analysis of the song structure. The analysis of the Balkan songs shows the simplicity of their structure in comparison with complexes of plain

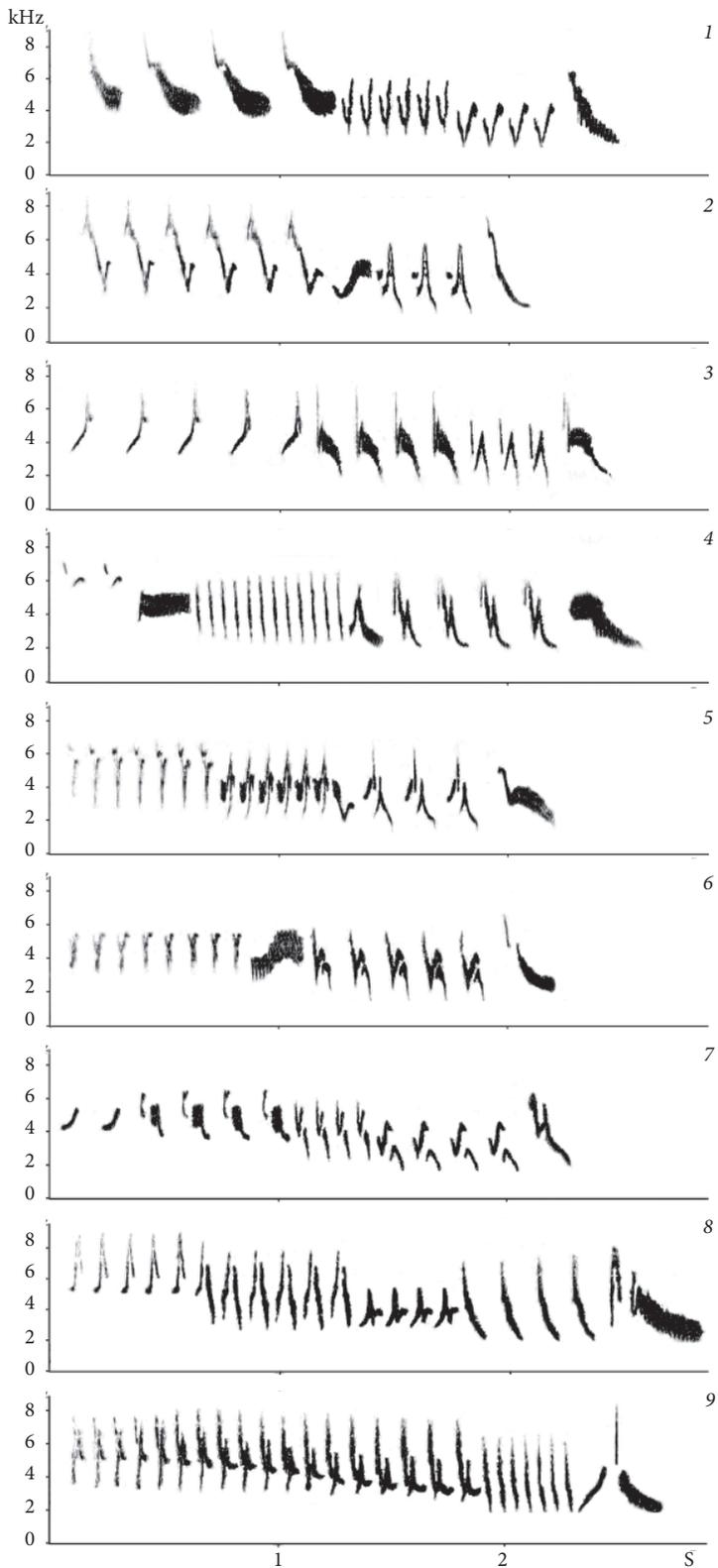


Fig. 1, 1–10. Sonograms of most frequent song types of Balkan chaffinches.

Рис. 1, 1–10. Сонограммы наиболее распространённых типов песен зябликов с Балкан.

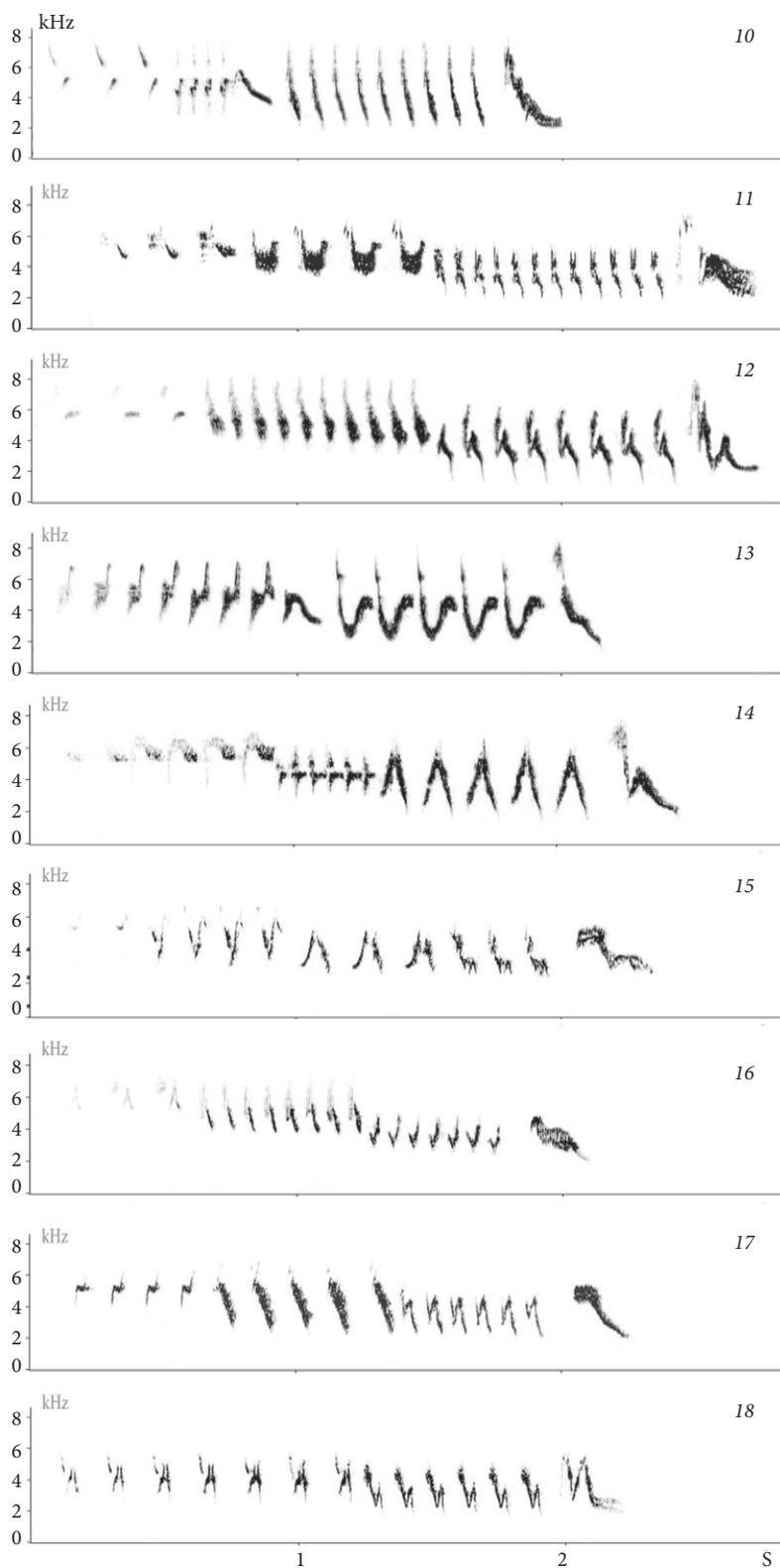


Fig. 1, 10–18. Sonograms of most frequent song types of Balkan chaffinches.

Рис. 1, 10–18. Сонограммы наиболее распространённых типов песен зябликов с Балкан.

Table 1. Structure of the chaffinch song types from different regions**Таблица 1. Структура типов песен зябликов из разных регионов**

Song parts	Balkan n = 39		Carpathians n = 58		Caucasus n = 191		Crimea n = 38		Plain Ukraine n = 191	
	X ± S.E.	lim	X ± S.E.	lim	X ± S.E.	lim	X ± S.E.	lim	X ± S.E.	lim
Repeated elements phrases	2.87 ± 0.10	2-4	2.84 ± 0.08	1-4	2.85 ± 0.04	1-4	2.50 ± 0.11	1-4	3.02 ± 0.05	1-5
Inserted elements	0.33 ± 0,08	0-1	0,31 ± 0.08	0-2	0,43 ± 0.04	0-2	0.71 ± 0,14	0-3	0.66 ± 0.07	0-3
Pre-flourish elements	0.33 ± 0,08	0-1	0.38 ± 0.07	0-2	0.31 ± 0.04	0-3	1.32 ± 0,16	0-3	1.04 ± 0.05	0-2
Flourish elements	1	1	1	1	0.98 ± 0.01	0-1	0.97 ± 0,03	0-1	1	1
All	4.56 ± 0.13	3-6	4.55 ± 0.14	3-8	4.58 ± 0.07	2-7	5.47 ± 0.15	3-7	5.80 ± 0.09	3-8

Ukraine and the Crimea (table 1): in Balkan chaffinch songs the average number of phrases is reliably less ($t = 7.8$; $p < 0.001$ and $t = 4.6$; $p < 0.001$ correspondingly) as well as number of inserted elements ($t = 3.2$; $p < 0.05$ and $t = 2.5$; $p < 0.05$) and pre-flourishes elements ($t = 7.8$; $p < 0.001$ and $t = 5.6$; $p < 0.001$). However Balkan songs are similar by structure to songs sampled in the Eastern Carpathians and the Caucasus. For all examined parameters reliable differences between these complexes have not been found. But the Balkan songs are more primitive than Carpathian or Caucasian ones. They include no more than one inserted or one pre-flourish element. There are no more than 6 strophes.

Most of discrete elements of chaffinch song are widespread but some of them may be peculiar to some regions (Yablonovska-Grishchenko, Grishchenko, 2007). A large quantity of our data processed by the same method allows comparing songs' elements from the Eastern Carpathians, Crimea, plain Ukraine and the Balkans (unfortunately, published sonograms of the Caucasian chaffinches are of insufficient quality for correct analysis of song elements). Only 5 elements of 106 are specific for the Balkans. Thirty seven elements are common for the East Carpathians and the Balkans but they were not found in the Crimea and plain Ukraine. Elements, common for the Carpathians and Balkans, may be an evidence of remote relations of these territorial song complexes and/or preservation of relic elements in south mountain complexes. Preservation of archaic complexes in mountains was supposed by Simkin (1983).

Comparative analysis of the rain-calls. It is of particular interest when analyzing separate song elements to also compare so-called "rain-calls" of studied populations (the signals are made of simple homogenous elements). Rain-calls are sequences of rhythmic sounds uttered by Chaffinch males during the nesting period predominantly if they are distressed. Significance of a rain-call is close to that of a song (Thielke, 1976). Different Chaffinch populations may have radically different rain-calls: throughout the vast species range, several highly distinctive rain-call dialects were found. Comparative analysis of Chaffinch rain-calls revealed that signals of Balkan birds were drastically different from analogous signals of Chaffinches from the Crimea, plain Ukraine and Eastern Carpathians but completely identical to signals of Caucasian birds (Tsvelykh, 2011; Tsvelykh, Yablonovska-Grishchenko, 2013). It is assumed that Chaffinches from the Caucasus and Asia Minor and some of the Balkan regions belong to one geographical population of subspecies *Fringilla coelebs caucasica* Serebr. (Matvejev, Vasic, 1973; Tsvelykh, 2011).

Conclusion

There are 39 identified song types in the repertoire of North-eastern Balkan Chaffinches. Comparisons of Balkan Chaffinch songs with those of birds from the Caucasus, Eastern Carpathian Mountains, Crimea and plain Ukraine revealed no common song types. Typological song structure of Chaffinches from Balkan region is very different from that of birds from plain Ukraine and the Crimea but quite similar to song structure of birds from

the Caucasus and Eastern Carpathians. Analysis of separate song elements disclosed that out of 106 elements in songs of Balkan birds, 5 were locally unique. Thirty seven elements were common to Chaffinch populations from the Balkans and Eastern Carpathians and absent in songs of birds from plain Ukraine and the Crimea. Occurrence of shared elements in bird songs from the Balkans and Eastern Carpathians possibly attests to remote relations between these regional song complexes and/or preservation of some common relic elements in songs of these geographically dissociated mountainous populations. Comparative analysis of Chaffinch rain-calls in studied regions demonstrated commonality between birds from Balkan region and the Caucasus and their distinct differences from birds of the Eastern Carpathians, plain Ukraine and Crimea.

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