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ARCHAIC DIALECT OF CHAFFINCH, *FRINGILLA COELEBS* (PASSERIFORMES, FRINGILLIDAE), SONG IN THE LOWER-DNIPRO AREA (SOUTH UKRAINE) AND ITS TERRITORIAL RELATIONS

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Archaic Dialect of Chaffinch, *Fringilla coelebs* (Passeriformes, Fringillidae), Song in the Lower-Dnipro Area (South Ukraine) and Its Territorial Relations. Yablonovska-Grishchenko, E. D., Grishchenko, V. N. — Archaic song dialect of Chaffinch (*Fringilla coelebs* Linnaeus, 1758) is located in the Lower-Dnipro Area. To describe it, we recorded 11673 songs of 2008 males from 43 localities in Southern Ukraine during 2004–2015. This dialect has compound spatial structure and connects with other dialects forming a well developed contact area with them. Its core was located in old forests of the lower stream of the Dnipro River. It has spread from them to the new forests in their outskirts. The complex is separated at dialect level in the cluster analysis. It includes considerable number of original song types. Their elements and structure demonstrate archaic features similar to those of other southern complexes but more modern than the old Carpathian and Danube dialects. It occupies the intermediate position between them and modern dialects of the Forest and Wood-and-Steppe Ukraine by the structure of song and is similar to the dialect of Crimean Chaffinch and the song complex of South-Eastern Ukraine.
Key words: Chaffinch, Lower-Dnipro Area, song dialect, song type, similarity, cultural transmission.

Introduction

The song dialects were found to exist in different bird species and have been studied for many years. The most actual questions of the current studies in bird songs are the territorial structure of dialect, changes of structure of songs and their complexes, and the time of changes diversity in song complexes (Petrusková et al., 2015; Zimmerman et al., 2016; Diblíková et al., 2019; Lee et al., 2019; Paxton et al., 2019; Williams et al., 2019, etc.). Dialects for Chaffinch (*Fringilla coelebs* Linnaeus, 1758) were registered for different countries of Europe (Conrads, 1966; Böhner, Wistel-Wozniak, 1995; Joachim, Lauga, 1996, etc).

Six dialects of Chaffinch song we described for Ukraine. Three main dialects were found in Forest and Wood-and-Steppe zones and Ukrainian Carpathians (using zoogeographical division of Ukraine by Shcherbak, 1988): two of them are widespread in the plain (Left-bank and Right-bank of Dnipro) and another located in the Carpathians (Yablonovska-Grishchenko, Grishchenko, 2007 a; Yablonovska-Grishchenko, 2008). Each of the plain dialects includes two sub-dialects and contact areas between them. The largest Dnipro contact area was found between the dialects of plain. Carpathian dialect with archaic features has no strongly expressed contact area with the Right-bank dialect (Yablonovska-Grishchenko, Grishchenko, 2008). The song complex of the Crimean subspecies of Chaffinch (*Fringilla coelebs solomkoi* Menzbier & Sushkin, 1913) is separated as a dialect with archaic features similar to the Carpathian one (Tsvelykh, Yablonovska-Grishchenko, 2012; Yablonovska-Grishchenko et al., 2014).

We supposed the presence of specific dialects with some archaic features in the Steppe zone, because the natural old forests in steppe are insular and segregated from the other ones. Their song complexes were formed independently (Yablonovska-Grishchenko, Grishchenko, 2007 a). As the result, we have found three specific song complexes. Two of them we described at the level of separate dialects: in Lower Danube (Yablonovska-Grishchenko et al., 2011) and in Lower Dnipro (Yablonovska-Grishchenko, Grishchenko, 2010). The third one from the South-East of Ukraine was separated at the level of a specific well-determined sub-dialect of the Left-bank dialect (Yablonovska-Grishchenko, Grishchenko, 2011). The dialect of Crimean Chaffinch shows apparent connections with them.

The complex of original features of the songs with archaic context was found in detailed studies of the Lower-Dnipro dialect. This whole dialect is situated on the territory of Ukraine. As the result, exact borders of the dialect core and the contact area were located and described.

This paper aimed to describe characteristics of the Lower-Dnipro song dialect of the Chaffinch and to analyze its specificity and connections with the other dialects.

Material and methods

Terminology

1. **Song type** is the constant sequence of sounds with specific structure (phrases, inserted elements, "flourish", etc.) (fig. 1). This sequence is invariable for each separately taken song, when it is performing by different birds and differs from other sequences. **Subtypes** were described in case of difference in one or two phrases or elements.

2. **Dialect** is a steady song complex characteristic for sizeable territories. It differs from other complexes characteristic for other territories.

3. **Contact area** (Baptista 1977) is a zone between dialects (sub-dialects), where birds use songs of both dialects (sub-dialects).

4. **Universal song types** were registered in the most part of study area (Ukraine) and in the most part of described dialects.

5. **Dialectal types** were registered in the most parts of localities of dialect. Dialect is described by them.

6. **Dialect-forming types** are a complex of dialect and universal types of a certain dialect.

7. **Regional types** are found in the part of localities of dialect, located one near another.

8. **Local types** are found from some birds of one locality.

9. **Unique types** find just from one bird.

Study area

In this paper, songs from 43 localities of the southern part of Ukraine were analysed (table 1, fig. 2); 11,673 songs of 2008 males were recorded in 2004–2015.

The number of records for any point must be sufficient because the song complexes were divided using statistical analysis. Calculations showed that sample from records of 30 and more males includes more than 50 % song types (Yablonovska-Grishchenko, Grishchenko, 2007 b). Therefore, songs of at least 30 males were recorded in each point.

Acoustic recordings

We recorded songs using digital camcorders Sony TRV-110E and TRV-550E with external microphones and linear recorder Olympus LS11. Sound files were saved in Wave-format. Sound data were not compressed. Sonograms were generated using Sonic Foundry Sound Forge 5.0 and Syrinx 2.5s (John Burt http://www.syrinxpc. com).

Statistical song analysis

We used the original semi-quantitative method of song similarity analysis (Yablonovska-Grishchenko, 2006) for comparison elements and description of song types. This method allows decreasing of subjectivity

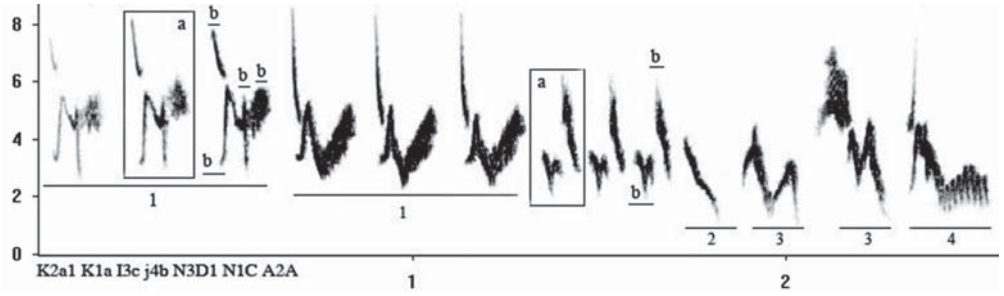

Fig. 1. Components of Chaffinch song structure: 1 — phrase; 2 — inserted element; 3 — pre-flourish; 4 — flourish. a — element; b — sub-element.

Table 1. Study area (codes of localities at the map and dendrogram are corresponding this table)

Code at map	Name of point	Region	Description of point	Years of recording	Number of individuals	Number of songs
03–01	Marganets	Dnipro	Marganets City	2009, 2010	34	225
03–02	Pavlohrad	Dnipro	Samarskyi forest, outskirts of Bulakhivka village	2008	61	340
03–03	Pokrovske	Dnipro	Outskirts of Velykomykhailivka village	2009	54	340
03–04	Piatykhatky	Dnipro	Outskirts of Piatykhatky town	2009	35	237
04–03	Volodarske	Donetsk	Azovska dacha forest, outskirts of Volodarske town	2009	41	218
04–05	Yasynuvata	Donetsk	Outskirts of Avdiivka town	2009	34	219
07–01	Komyshuvakha	Zaporizhzhia	Outskirts of Komyshuvakha town	2009, 2010	41	267
07–02	Kuibysheve	Zaporizhzhia	Kamenska dacha forest (outskirts of Kuibysheve town)	2009	32	128
07–03	Molochnyi lyman	Zaporizhzhia	Molochnyi lyman, outskirts of Bohatyr and Radyvonivka villages	2008, 2009	49	333
07–04	Tokmak	Zaporizhzhia	Outskirts of Makivka village	2010	31	193
07–05	Yakymivka	Zaporizhzhia	Outskirts of Sheliuhy village	2011	37	177
07–06	Melitopol	Zaporizhzhia	Outskirts of Melitopol City	2011	63	608
07–07	Energodar	Zaporizhzhia	Enerhodar town	2011	37	256
09–09	Stavyshche	Kyiv	Outskirts of Snizhky village	2008	40	176
10–01	Dolynska	Kirovohrad	Outskirts of Hurivka village	2009	39	221
10–02	Nerubaika	Kirovohrad	Nerubaika forest	2005, 2008, 2010, 2011	60	261
10–03	Pomoshna	Kirovohrad	Husarskyi forest, outskirts of Piddubne village	2008	47	225
10–04	Chornyi Lis	Kirovohrad	Chornyi Lis forest	2005, 2009, 2010	57	274
10–05	Chuta	Kirovohrad	Chuta forest	2005	43	280
11–01	Armiansk	Crimea	Outskirts of Armyansk town	2010, 2011, 2013	38	295
14–01	Berezanka	Mykolaiv	Outskirts of Berezanka town	2009, 2011	37	274
14–02	Voznesensk	Mykolaiv	Ratsynska dacha forest	2008	49	226
14–03	Mykolaiv	Mykolaiv	Outskirts of Mykhailo-Laryne village	2009, 2011	46	350
14–04	Novyi Buh	Mykolaiv	Outskirts of Anastasivka village	2008	53	274
14–05	Pervomaisk	Mykolaiv	Outskirts of Pervomaysk sity, outskirts of Kamianyi Mist and Katerynka villages	2009	42	252
15–02	Balta	Odesa	Outskirts of Lisnychivka village	2010	52	330
15–03	Berezivka	Odesa	Berezivka town	2009, 2011	59	258
16–03	Kobeliaky	Poltava	Outskirts of Kobeliaky town	2008	38	235
20–02	Zmiiv	Kharkiv	National park “Homilshanski lisy”	2006	46	229
20–03	Izium	Kharkiv	Regional park “Iziumska Luka”	2006	32	148
21–01	Askania-Nova	Kherson	Biospare Reserve “Askania-Nova”	2008	78	469
21–02	Velyka Oleksandrivka	Kherson	Outskirts of Velyka Oleksandrivka town, Novodmytrivka village	2009	61	287
21–03	Hola Prystan	Kherson	Oleshkivski pisky — Lower-Dnipro sand arenas	2008, 2011, 2015	65	333
21–04	Hornostaivka	Kherson	Outskirts of Hornostaivka (Zavadivka and Kniazhohryhorivka villages).	2010	43	219
21–05	Skadovsk	Kherson	Outskirts of Skadovsk town	2010, 2011, 2013	32	170

Continue Table 1.

21–06	Kozachi Laheri	Kherson	Outskirts of Kozachi Laheri and Krynky villages	2010	56	345
21–07	Kinburn	Kherson	Kinburn spit, outskirts of Heroiske village	2011	61	442
21–08	Verkhnii Rohachyk	Kherson	Outskirts of Verkhnii Rohachyk town, Oleksiivka village	2011	57	431
23–07	Kamianka	Cherkasy	Outskirts of Tomashivka village	2007	55	225
23–09	Katerynopil	Cherkasy	Outskirts of Katerynopil town	2007	37	147
23–12	Uman	Cherkasy	Outskirts of Sobkivka village	2008	35	190
23–13	Kholodnyi Yar	Cherkasy	Kholodnyi Yar forest	2004	62	390
23–14	Shpola	Cherkasy	Outskirts of Lebedyn village	2007	39	176

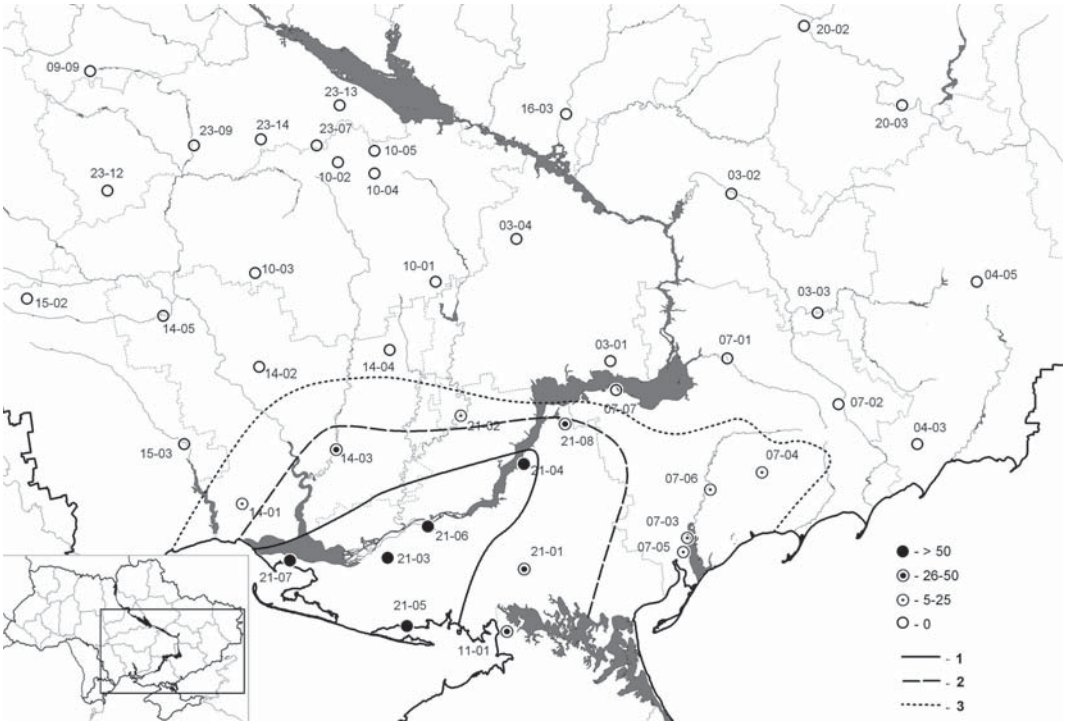

Fig. 2. Study area and Lower-Dnipro dialect territory: > 50 — localities with more than 50 % specific dialectal Lower Dnipro song types in song complex; 26–50 — specific dialectal types constitute 26–50 % of song complex; 5–25 — dialectal types constitute 5–25 %; 0 — specific dialectal types were not found.
1 — core of dialect; 2 — periphery of dialect, 3 — contact area.

in sonogram analysis. Any element is described as a complex of epithets ("formula of element"). After the comparison these formulas were received alphanumeric code with the use of cluster analysis. Sequence of alphanumeric codes of song elements formed a "song formula".

Comparison of song complexes was implemented using lists of song formulas. Song types from one locality were united in territorial complex. Similarity measure between these formulas was determined using Chekanovsky-Sørensen index. Dendrogram of similarity of the territorial complexes from different localities (fig. 3) was got by the Ward's minimum variance clustering method (Pesenko, 1982) in PAST 1.65 (Hammer et al., 2001).

Contact areas were determined using different methods of clustering (single linkage and paired group using similarity measures: Euclidian distance, Morisita, Manhattan, correlation, Ward's method). Dialect clusters stayed stable, but contact areas clusters joined with different clusters when different methods of clustering were used because their complexes include songs of different dialects.

Some localities (as Novyi Buh) with depleted song complexes were contained only dialectal and universal song types. They may be associated with clusters of complexes of other territorial locations, because they contain a few types.

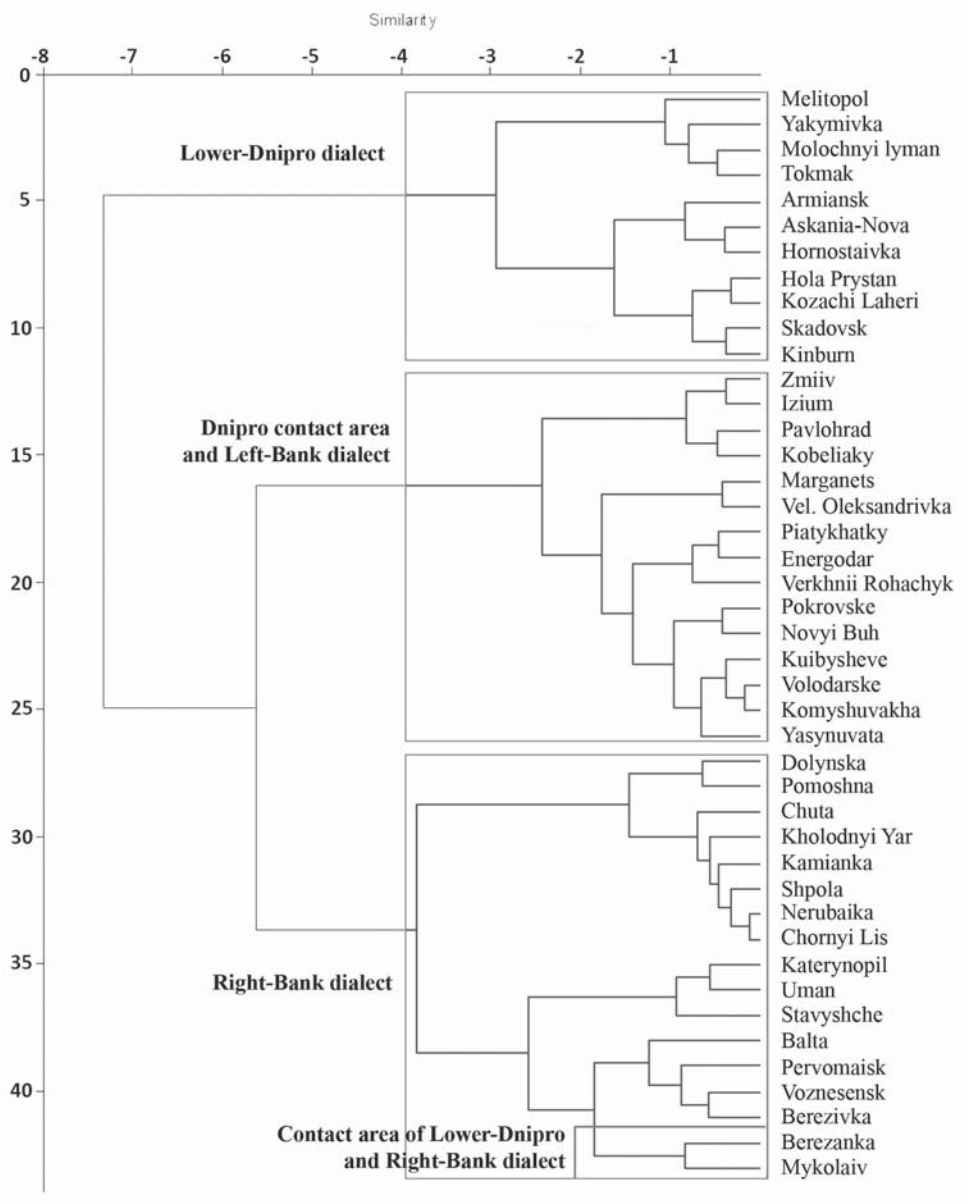

Fig. 3. Dendrogram of territorial complexes Lower-Dnipro Area (localities are described in table 1).

A part of specific types in the dialect-forming song complex for each locality was counted for description of dialect structure. The core of dialect is a territory with more than 50 % specific song types in the dialect-forming complex. The complex of peripheral zone of dialect includes more than 25–50 % of specific song types. The contact area has more than 5–25 % specific song types. We used 5% level of registrations of specific types as verge between rare regular findings and occasional visits of birds from one dialect of territories of another.

Mean values ± standard deviation are given.

Results

The territorial complex of Chaffinch songs in the forests of Lower Dnipro River and adjacent areas (Lower-Dnipro dialect) possesses a high degree of specificity and its complex of localities is separated at the level of dialect on the dendrogram (fig. 3).

Territory of dialect

Distribution of this dialect demonstrated with points on the map marked with the part of specific song types do not found in other dialects (fig. 2). Core of dialect included sites with these types number more than 50 % of registered in it. It placed as narrow band at the left bank of Lower Dnipro in forests of Lower Dnipro sand arenas.

Two belts around the dialect core with gradual decrease in number of the specific types were detected. The inner belt included 26–50 % of them. The outer belt (5–25 %) we considered as contact area with other dialects.

The main part of the dialect (core and inner belt) is located in lower parts of the rivers South Bug, Ingulets, Dnipro and a part of Dnipro–Molochna River interfluve (Mykolayiv and Kherson Regions of Ukraine). In the South, it bounded by the Black Sea, but invades to Perekop isthmus in Crimean Peninsula by artificial forests. In this place, the Crimean Chaffinches (*F. c. solomkoi*) were met sometimes. Here, the number of birds of both subspecies is very low, and normal contact area is not formed (Yablonovska-Grishchenko et al., 2014).

The peripheral zone (26–50 %) of dialect is located from Molochna River and Verkhniy Rogachyk at the left bank of Dnipro and along the Dnipro-Bug estuary to Mykolaiv at the right bank.

The contact area (5–25 %) stretches over Molochna River from Molochny Lyman to Yushanly River and to Energodar at left bank and from Velyka Olexandrivka to Berezivka at the right bank (fig. 2). Incidentally, several specific types were found only in the contact area at Molochna River.

Peculiarities of dialect

Seventy-seven song types in total were found for the all dialect territory including the main part of dialect (core and peripheral zones) with the contact area. From 13 to 24 types (mean 16.9 ± 2.9) were described in each locality of record.

We recorded 45 song types in total for territory of core and peripheral zone of dialect; 25 (56 %) of them were specific, they were registered only in the Lower-Dnipro dialect: 16 — dialectal (fig. 4), 4 — regional, 2 — local, 3 — unique; 3 types were universal, they occurred in several other dialects; 17 types were common with one of neighbouring dialects.

The complex of dialect-forming types in the core of dialect included 22 types: 2 (9 %) of universal types, 14 (64 %) specific dialectal types of the Lower-Dnipro dialect and 6 (27 %) dialectal ones of other dialects.

In the contact area, we have found 52 song types; 27 from them were specific for this dialect: 14 — dialectal (4 specific for this area, 10 common with the main part of the dialect), 6 — regional, 7 — unique; 3 types are universal, 22 types common with one of neighbouring dialects.

Song structure of this dialect is quite complicated among other dialects of Chaffinch song in Ukraine (table 2). Dialectal types have 4–7 (5.6 ± 0.7, n = 16) phrases including single elements (inserted, pre-flourishes, flourishes). Inserted elements were found in 2/3 of these song types. Pre-flourishes were in the most part of songs, 3 song types include 2 pre-flourishes.

In the songs of Lower-Dnipro dialect, 35 “southern” elements specific for the song complexes of Southern Ukraine were found (fig. 5). These elements were not recorded in plain dialects (except a specific South-East sub-dialect of Left-bank dialect). For the most part, the elements of beginning and middle of song (18 elements, 51 %). 5 elements (14 %) were connected with flourishes and pre-flourishes. One element was only inserted. Other elements were registered in different parts of song. Whistles, harmonics and trills were among them. The most part of these elements were found not only in Lower-Dnipro dialect, but in South-East sub-dialect of Left-bank dialect, Crimean, Danube and Carpathian dialects too.

Relations with other dialects

Thus, the Lower-Dnipro dialect is characterized by high diversity and high specificity of song types: 64 % (to 84 % in some localities) of dialect-forming types in the core of

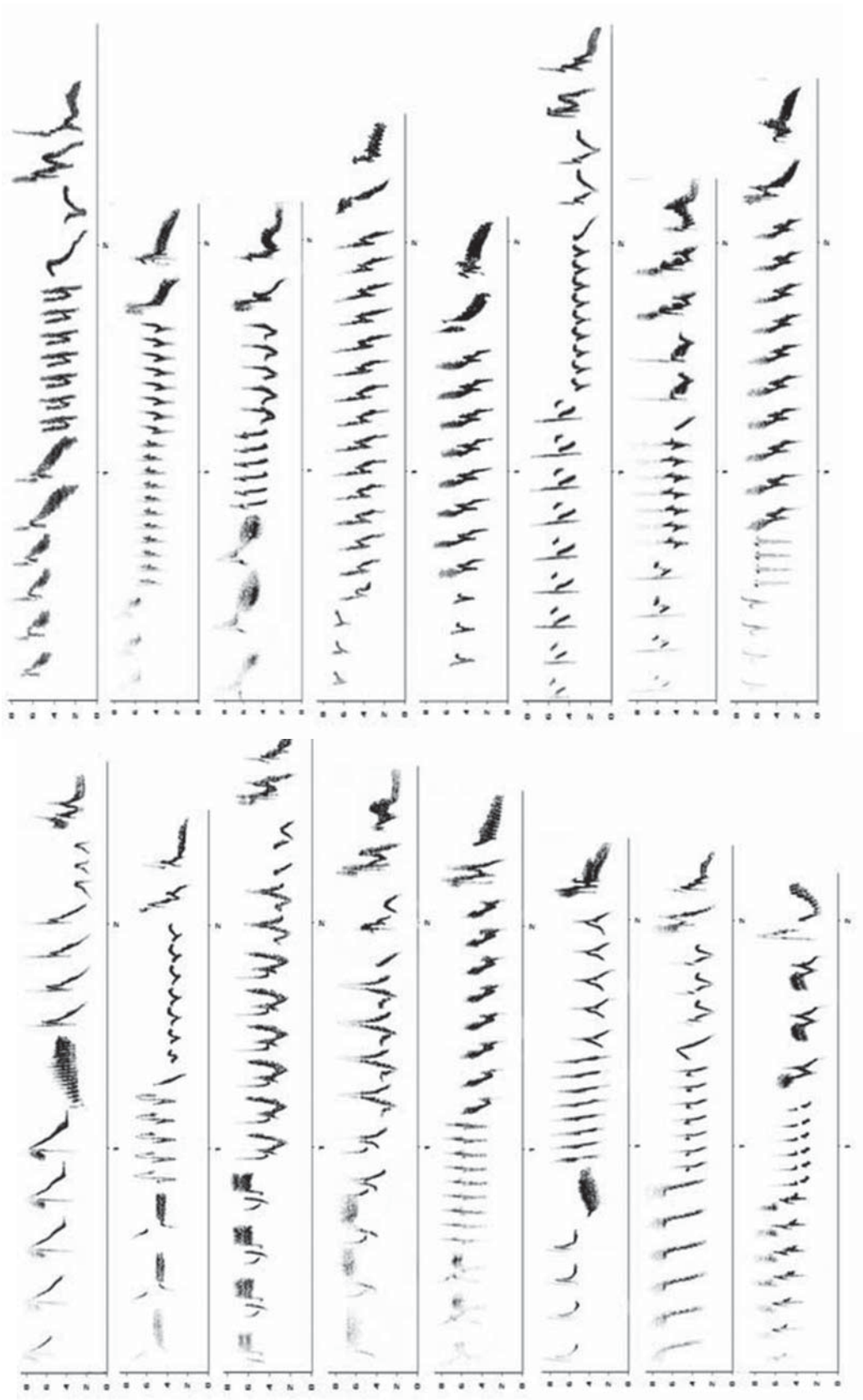

Fig. 4. Dialectal song types of the Lower-Dnipro dialect.

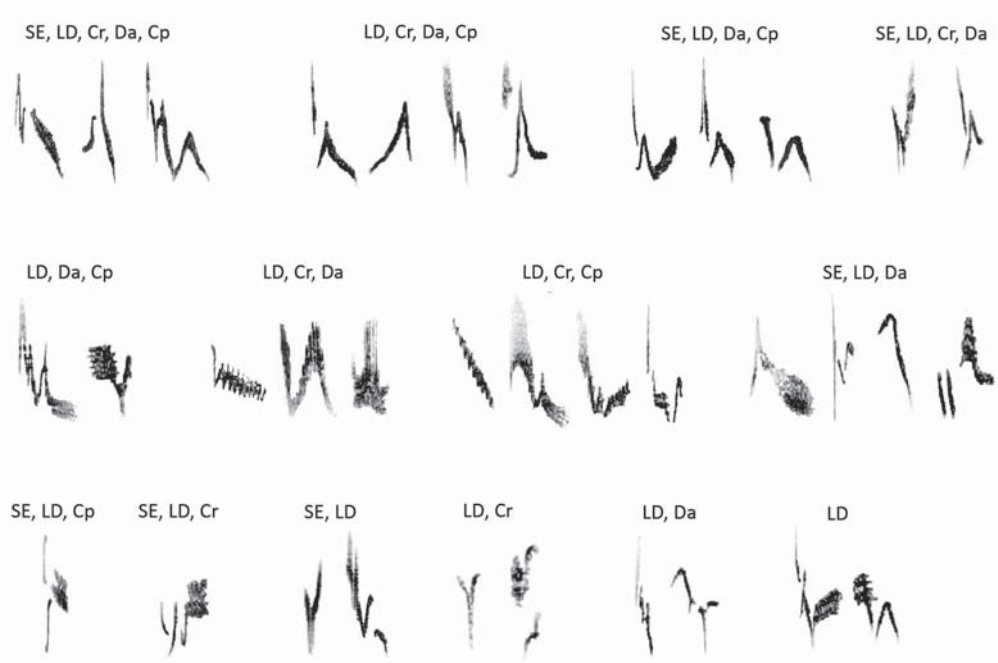

Fig. 5. Specific "southern" elements in Lower-Dnipro dialect. Elements found in song complexes of South Ukraine: LD — Lower-Dnipro dialect; SE — South-East sub-dialect of Left-bank dialect; Cr — Crimean dialect; Da — Danube dialect; Cp — Carpathian dialect.

dialect were not found in other dialects occurring in Ukraine. Dialectal types of other dialects were found in it, can be used by birds from other territories who kept in forests of Lower Dnipro.

Lower-Dnipro dialect is connected with other song complexes of the South Ukraine as well through some song types as through specific elements.

One of three registered universal types is characterized by the high level of diversity in Lower-Dnipro and Danube dialects (8 and 7 subtypes). At the same time, it was represented only as one or two subtypes in plain dialects.

For other song types similar results were shown. The closest relation is registered for Lower-Dnipro and Danube (6 common specific types). Two common types were found for Lower-Dnipro and Crimean and for Lower-Dnipro and South-East. Three types are common for Lower-Dnipro, Danube and South-East. At the same time, Carpathian dialect has no common southern types with other complexes with the exception of Danube one (1 common type).

Of the elements, 22 were shared with the Danube dialect, 18 — with the Crimean one, 17 — with the Carpathian one, 15 — with the South-East sub-dialect. Some elements were registered in more then two dialects. This case allows mark out lines of relations like Crimean — Lower-Dnipro — Danube — Carpathian (12 common elements), Crimean — Lower-Dnipro — South-East (5 common elements), South-East — Lower-Dnipro — Danube — Carpathian (7 common elements). Three elements were found in all south song complexes.

Discussion

Lower-Dnipro dialect in dialect structure of Chaffinch song in Ukraine

The most part of Left-bank Ukraine is occupied by southern (Wood-and-Steppe) sub-dialect of the Left-bank dialect. It is represented in Steppe zone as depleted complexes of artificial forests. These complexes were formed recently in

new afforestations. However, specific sub-dialect with archaic features was found in old forests of the South-Eastern Ukraine (Donets chain of hills) (Yablonovska-Grishchenko, Grishchenko, 2011).

Right-bank dialect represented in Steppe as depleted complexes too.

Lower-Dnipro dialect is situated between these dialects. Steppe divides it from other dialects everywhere with the exception of forests along Dnipro River.

History of dialect

Lower-Dnipro dialect is placed in old forests of flood-plain of Dnipro and new afforestations around them.

This spatial structure of dialect, especially allocation of dialect core, allows to reconstruct the history of this dialect. Allocation of the core of dialect is not only the Lower-Dnipro sand arenas but along the Dnipro and Dnipro-Bug estuary allows to suppose this specific complex kept in the forests of the flood plains after destruction of the large old forests in the Lower-Dnipro (Pogrebnyak, 1953; Gordiyenko, 1969). However, it expands to new artificial forests because the "native speaking" Chaffinches of this dialect occupied them. The inflow of northern songs was difficult inasmuch the absence of the forest "corridors" in Steppe.

Colonization of Askania-Nova afforestations by Chaffinches was observed at the end of XX century (Gavrylenko, 2001). In 2008, a detailed analysis of the structure of the Askania-Nova song complex showed that it is complete (Yablonovska-Grishchenko, Grishchenko, 2010). It includes both the Lower-Dnipro and the Left-bank song types. This structure of complex indicates colonization of this forest from both the flood plains of the Dnipro and the afforestations along the channels. However, complexes near the Dnipro include less Left-bank songs and more the Lower-Dnipro songs than in Askania-Nova.

Song structure changes in the time of colonization of "empty" territories without regularly inflow of the "native speaking" birds. This phenomenon was registered for Chaffinch in New Zealand, where this species was introduced in late XIX century (Lynch et al., 1989). Similarity with initial song types decreased in every next new point of resettlement. In the case of Askania-Nova colonization the song structure and song complex, however, did not change compared with the complexes of Lower Dnipro floodplain forests, because Askania complex regularly replenished from birds of these territories of the dialect core.

Thus, even at the small territory of old forests in flood plains before colonization, this dialect contained high song diversity, without its considerable declining, for a long time. It is possible because local population of "native speakers" was numerous all the time of dialect existence. Otherwise, the song diversity declines (Pang-Ching et al., 2018; Paxton et al., 2019), and the number of songs would be incomparably lesser than in other dialects.

Comparison of dialects of Chaffinch song in Ukraine

The Lower-Dnipro dialect is characterized by high specificity of song complex for a small territory (16 dialect types and 27 specific types in all). Another song complex with similar song diversity is the South-Eastern sub-dialect of the Left-bank dialect. Eighteen specific types were found at its bounded territory. For comparison, 11 dialect types are in the Right-bank dialect, 9 ones are in the Left-bank and 8 are in the Carpathians. Danube dialect has 42 specific types, but dialectal types are not separated because only small part of it is situated in Ukraine. Only 12 types in all localities of this dialect were found in Ukraine. Specific types are represented on the large territory not only as dialect types but as regional types too. Regional types are registered only on the part of dialect territory. These types are not differentiated in small-territory dialects.

Song structure keeps intermediate position between Carpathian and Danube dialects, on one hand, and plane dialects, on the other. Similar song structure is characteristic for the South-eastern sub-dialect of the Left-bank dialect too, as well as song complex of the Crimean Chaffinch. This complex separated at the level of dialect in the dendrogram, as these songs differ slightly from *F. c. coelebs* ones.

Table 2. Structure of dialectal song types for different song complexes of Chaffinch in Ukraine

Complex	Number of types	Phrases including single elements		Phrases without single elements		Inserted elements		Pre-flourishes	
		lim	M ± sd	lim	M ± sd	lim	M ± sd	lim	M ± sd
Danube dialect	12	3–5	4.1 ± 0.8	2–3	2.8 ± 0.4	0–1	0.2 ± 0.4	0–1	0.2 ± 0.4
Carpathian dialect	8	4–6	4.8 ± 0.7	2–4	3.0 ± 0.5	0–2	0.5 ± 0.8	0–1	0.3 ± 0.5
South-East sub-dialect	18	4–8	5.4 ± 1.0	2–4	2.9 ± 0.7	0–4	0.3 ± 1.0	1–2	1.2 ± 0.4
Lower-Dnipro dialect	16	4–7	5.6 ± 0.7	2–3	2.7 ± 0.5	0–1	0.7 ± 0.5	0–2	1.1 ± 0.6
Crimean dialect	14	5–7	5.6 ± 0.7	2–4	2.9 ± 0.7	0–2	0.6 ± 0.8	0–3	1.1 ± 1.0
Left-bank dialect	9	5–7	5.8 ± 0.6	2–3	2.9 ± 0.3	0–1	0.4 ± 0.5	1–2	1.4 ± 0.5
Right-bank dialect	11	5–8	6.5 ± 0.8	2–5	3.3 ± 0.8	0–2	1.1 ± 0.8	1–2	1.2 ± 0.4

A large number of peculiar harmonic (and less the trill) elements in phrases was detected in Lower-Dnipro dialect, as well as in other archaic complexes of the South Ukraine. High diversity of different sound types in the elements is a characteristic archaic feature of these dialects. However, complicated song structure with using of the large number of phrases, inserted elements and pre-flourish elements make to admit theirs certain similarity with "recent", modern dialects of plain.

Belt of archaic complexes in the South of Ukraine

Two features of Lower-Dnipro songs are especially interesting. First, the elements specific for dialects of the South of Ukraine and Carpathians were found. Second, peculiarity of song construction is registered in Lower-Dnipro, Crimean, Danube, Carpathian dialects and South-East sub-dialect of Left-bank dialect: harmonic elements (or rarely, trills) are located not only as single elements, but in phrases too.

These peculiarities may be considered as archaic. They are distinctive for songs of the "small dialects" of the South Ukraine localized in the small territories of forests separated from Forest and Wood-and-Steppe geographic zones by Steppe zone, and for the songs of the Carpathian dialect. These relations between dialects allow describe "the Southern belt of archaic complexes". It includes foregoing ones.

The most strongly pronounced archaism is registered for Carpathian and Danube dialects. The simplest song structure, the least number of phrases in it (table 2) were found in these dialects. Often phrases are composed of harmonic or (rarer) trill elements. Often whistle elements of phrases are protractedly sounding (more then 0.19 s). Many of the specific "southern" elements were found in these dialects too.

Other group of archaic song complexes includes Crimean and Lower-Dnipro dialects and South-East sub-dialect of the Left-bank dialect. Their songs have more complicated structure (table 2). However, peculiarities of elements of phrases are similar to Carpathian and Danube. Some of these "southern" elements are common for both groups of complexes in Southern belt. Some song types were found in the south dialects, but not in the northern plain ones. One of the universal types was registered in south complexes as subtypes with specific marked element. Such form of this type was not found in the northern dialects.

Specific elements are constant in their structure at all territory of their dialect (s) and do not demonstrate any signs of cline variation both inside and outside the dialect (s), in contrast to them, for example, for Daurian Redstart (*Phoenicurus auroreus*) (Lee et al., 2019). This stability of song complexes at wide territories can be explained by long time constancy of these dialects for much more long-time then described for some other species (Planqué et al., 2013; Ramsay, Otter, 2015; Zimmerman et al., 2016).

Thus, Lower-Dnipro dialect is positioned in centre of this belt and links its complexes.

These data confirm a clear relation between south song complexes. In our opinion, earlier they were parts of one unified ancient dialect. It was separated at the time of last (Würm) glaciation. Its surviving parts had remained in forest refugia. Henceforth they developed independently. Such refugia existed in middle stream of Dnipro, Lower Dnipro, Donets chain of hills, near Carpathians (Markova et al., 2008; Simakova, 2008). Allocation of dialects corresponds to allocation of forest vegetation in the I millennium (by maps

of Gensyruk, 1975, 1995). The same allocation of modern dialects in compliance with ancient allocation of vegetation was described, for example, for Rufous-collared Sparrow (*Zonotrichia capensis*) (Lougheed, 1991).

Inclusion of new song types in fully formed complex is difficult in consequence of cultural transmission mechanisms influence. Nestlings learn most-used song types from surroundings of the nest (Beecher at al., 1994; Bell et al., 1998), i. e., new song types may not "copy" and do not pass from generation to generation.

Preservation of song complexes is facilitated by theirs isolations. The Lower-Dnipro dialect remained intact and detached due to isolation by wide belt of the Steppe. Crimean dialect was developed in a similar manner, taking into account its subspecies isolation. These dialects were evolved independently, without external actions.

However, massed inclusion of new song types can lead to "washing out" of complex. For example, some specific archaic song types were found at the territory of middle stream of Dnipro refugium. They remain against background Left-bank and Right-bank song types of Dnipro contact area. South-eastern sub-dialect specific types were "washing out" by inflow of the Left-bank types. Number of specific types averaged about 50 % even in its core.

Carpathian and Danube dialects retain the highest number of archaic features. They communicate constantly with song complexes of Balkan. These complexes did not undergo to glaciation and kept archaic. Thus inflow of "ancient" song types from south allows preserve archaic features of Carpathian and Danube dialects.

Conclusions

1. The specific song dialect of the Chaffinch is located in the Lower-Dnipro Area in Southern Ukraine. It is well separated from the two dialects from Wood-and-Steppe zone. Core of this dialect is situated in forests on Lower-Dnipro Sand Arenas in Kherson Region. Peripheral zone ranges from Mykolayiv Region to Zaporizhzhya Region.

2. Song complex of core and peripheral zone included 45 types total. 25 (55.6 %) of them were specific for this territory only, 16 are dialectal. For this dialect is characteristic the compound structure of songs, considerable number of original elements with many archaic features.

3. The Lower-Dnipro dialect is related to other ones in South Ukraine (Danube and Crimean dialects and South-Eastern song complex). There are also some common elements with the Carpathian dialect. This dialect is situated the central part of the belt of old song complexes from the Carpathians to South-East of Ukraine including dialect of Crimean Chaffinch subspecies.

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References

Baptista, L. F. 1977. Geographic variation in song and dialects of the Puget Sound White-crowned Sparrow. *Condor*, **79** (3), 856–870.

Beecher, M. D., Campbell, S. E., Stoddard, P. K. 1994. Correlation of Song Learning and Territory Establishment Strategies in the Song Sparrow. *Proceedings of the National Academy of Sciences*, **91** (4), 1450–1454.

Bell, D. A., Trail, P. W., Baptista, L. F. 1998. Song learning and vocal tradition in Nuttall's white-crowned sparrows. *Animal behaviour*, **55** (4), 939–956.

Böhner, J., Wistel-Wozniak, A. 1995. Chaffinch *Fringilla coelebs* song in western and southern Poland: Song types, repetoire sizes, and the terminal element "kit". *Acta ornithologica*, **30** (2), 107–115.

Conrads, K. 1966. Der Egge-Dialekt des Buchfinken (*Fringilla coelebs*) — ein Beitrag zur geographischen Gesangsvariation. *Vogelwelt*, **87**, 176–182 [In German].

Diblíková, L. et al. 2019. Detailed large-scale mapping of geographic variation of Yellowhammer *Emberiza citrinella* song dialects in a citizen science project. *Ibis*, **161** (2), 401–414.

Gavrylenko, V. S. 2001. Changes in ornithofauna of Biosphere Reserve "Askania-Nova" and its environs at lately 10 years. *Proceedings of Biosphere Reserve "Askania-Nova"*, **3**, 51–56 [In Ukrainian].

Gensyruk, S. A. 1975. *Forests of Ukraine*. Lesnaya promyshlennost, Moscow, 1–225 [In Russian].

Gensyruk, S. A. 1995. Changes in forest lands of Ukraine. *Oykumena*, **1–2**, 26–30 [In Ukrainian].
Gordiyenko, I. I. 1969. *Oleshkivsky sand arenas and biocenotic relations in process of theirs overgrow*. Naukova dumka, Kyiv, 1–243 [In Russian].
Hammer, Ø., Harper, D. A. T., Ryan, P. D. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica*, **4** (1), 1–9.
Lee, J.-H., Podos, J., Sung, H. 2019. Distinct patterns of geographic variation for different song components in Daurian Redstarts *Phoenicurus auroreus*. *Bird Study*, **66** (1), 1–10.
Joachim, J., Lauga, J. 1996. Populations et dialectes chez le pinson (Populations and dialects of the chaffinch in south-western France). *Comptes rendus de l'Académie des Sciences*, **319** (3), 231–239 [In Franch].
Lougheed, P. H. S. C. 1991. Variation in duration and frequency characters in the song of the Rufous-collared Sparrow, *Zonotrichia capensis*, with Respect to Habitat, Trill Dialects and Body Size. *Condor*, **93** (3), 856–870.
Lynch, A., Plunkett, G. M., Baker, A. J., Jenkins, P. F. 1989. A model of cultural evolution of Chaffinch song derived with the Meme concept. *The American Naturalist*, **133** (5), 634–653.
Markova, A. K., van Kolfskhoten, T., Bohnkke, Sh. et al. 2008. *Evolution of ecosystems of Europe at transition from pleistocene to holocene (24–8 thousands years ago)*. KMK, Moscow, 1–560 [In Russian].
Pang-Ching, J. M. et al. 2018. The effect of isolation, fragmentation, and population bottlenecks on song structure of a Hawaiian honeycrepro. *Ecology and Evolution,* **8** (4) 1–12.
Paxton, K. L., Sebastián-González, E. et al. 2019. Loss of cultural song diversity and the convergence of songs in a declining Hawaiian forest bird community. *Royal Society Open Science*. **6** (8), 190–219.
Pesenko, Yu. A. 1982. *Principles and methods of quantitative analysis in faunistic researches*. Nauka, Moscow, 1–287 [In Russian].
Petrusková, T. et al. 2015. A review of the distribution of Yellowhammer (*Emberiza citrinella*) dialects in Europe reveals the lack of a clear macrogeographic pattern. *Journal of Ornithology*, **156** (2), 263–273.
Planqué, R., Britton, N. F., Slabbekoorn, H. 2013. On the maintenance of bird song dialects. *Journal of Mathematical Biology*, **68** (1–2), 505–531.
Pogrebnyak, P. S. 1953. Lower Dnipro sand arenas and problems of their development. *Pryroda*, **8**, 56–61 [In Russian].
Ramsay, S. M., Otter, K. A. 2015. Geographic variation in White-throated Sparrow song may arise through cultural drift. *Journal of Ornithology*, **156** (3), 763–773.
Shcherbak, N. N. 1988. Zoogeographical division of Ukrainian SSR. *Vestnik Zologii*, **3**, 22–31 [In Russian].
Simakova, A. N. 2008. *Evolution of natural growth of Russian plain and West Europe in late pleistocene — middle holocene (33–4.8 thousands years ago) (by palinological data)*. Moscow, 1–32 [In Russian].
Tsvelykh, A. N., Yablonovska-Grishchenko, E. D. 2012. Song repertoire of the Crimean Chaffinch *Fringilla coelebs* (Fringillidae), and comparative analysis of the vocalization features of *F. c. solomkoi*, *F. c. coelebs* and *F. c. caucasica* subspecies. *Vestnik Zoologii*, **46** (6), 551–559.
Williams, H. et al. 2019. The buzz segment of Savannah sparrow song is a population marker. *Journal of Ornithology*, **160** (4), 217–227.
Yablonovska-Grishchenko, E. D. 2006. Semi-quantitative method of song similarity analysis on an example of Chaffinch songs in Ukraine. *Berkut*, **15** (1–2), 97–203.
Yablonovska-Grishchenko, E. D. 2008. *Spatial and temporal variability of Chaffinch (Fringilla coelebs coelebs L.) song at in Forest and Wood-and-Steppe zones of Ukraine and Ukrainian Carpathians.* Manuscript of Thesis for a candidate degree of biological science. Specialty 03.00.08 — zoology. — Schmalhausen Institute of Zoology, National Academy of Science, Ukraine. Kyiv, 1–227 [In Ukrainian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N. 2007 a. Dialects of Chaffinch song at in Forest and Wood-and-Steppe zones of Ukraine and Ukrainian Carpathians. *Berkut*, **16** (1), 111–112 [In Russian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N. 2007 b. The relationship between the number of registered song types and number of recorded males of Chaffinch (*Fringilla coelebs*). *Nature Reserves in Ukraine*, **13** (1–2), 69–72 [In Russian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N. 2008. Carpathian dialect of Chaffinch song. *Scientific bulletin of Uzhgorod university. Biological series*. **23**, 153–156 [In Ukrainian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N. 2010. Chaffinch song type complex in Askania-Nova and its territorial connections. *Nature reserves in Ukraine*, **16** (2), 76–83 [In Russian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N. 2011. Relic regional Chaffinch (*Fringilla coelebs*) song type complex in South-East of Ukraine. Ecology of birds: species, coomunities, interconnections. *In*: *Matherials of scientific conference dedicated to 150 anniversary of N. N. Somov (1861–1923), 1–4 December 2011, Kharkiv, Ukraine*. Kharkiv, **1**, 253–263. [In Russian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N., Tsvelykh, A. N. 2011. Danube dialect of Chaffinch song in South-West of Ukraine *Berkut*, **20** (1–2), 165–172 [In Russian].
Yablonovska-Grishchenko, E. D., Grishchenko, V. N., Tsvelykh, A. N. 2014. Geographic variation of songs of Crimean Chaffinch. *Berkut*, **23** (1), 40–55 [In Russian].
Zimmerman, H. D. et al. 2016. Evolution of white-throated sparrow song: Regional variation through shift in terminal strophe type and length. *Behaviour*, **153** (15), 1839–1861.

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