

Mixed song of Chiffchaffs in Northern Russia

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The Chiffchaff group of species or subspecies *Phylloscopus [collybita]* has received a remarkable amount of attention from taxonomists in recent times. It has been pointed out that the contact zone of the Siberian subspecies *tristis* and the Eastern European *abietinus* is not well studied (e.g. Helbig *et al* 1996). The degree to which breeding is assortive, has been controversial and is unclear. It has been speculated that the situation in the contact area may have similarities to that in the much better-studied contact zone between *ibericus* and *collybita* in the Pyrenees. The song and calls of *ibericus* differ distinctly from those of *collybita*, and there are some mixed singers in their contact zone (e.g. Salomon 1989, Salomon & Hemim 1992). However, the amount of hybridisation and gene flow is restricted, and *ibericus* is nowadays most often regarded as a species in its own right (Sangster *et al* 2002, AERC TAC 2003). The two subspecies with a wide European distribution, western *collybita* and eastern *abietinus*, have songs and calls which are very similar to each other, although Hansson *et al* (2000) describes a small difference in the pitch of the songs. The song and call of *tristis* are distinctly different from those of *collybita*, *abietinus* and *ibericus*, but the differentiation of mitochondrial DNA has been judged to be small, of about subspecies level (Helbig *et al* 1996). *Tristis* is commonly regarded as a subspecies of Common Chiffchaff *Phylloscopus collybita*.

In this article I comment on the songs of *tristis* and *abietinus*, their differences and the variation of songs in the contact area. The starting point is the articles by Martens & Meincke (1989) about the song of *tristis* and by Marova & Leonovich (1993) about the contact area between *abietinus* and *tristis*. This study was based on the

sound recordings of 195 different individuals of different Chiffchaff taxa. Mixed singing was especially studied. It is not, as such, a proof of hybridisation, because a considerable part of song is learned – it can be merely copying – but in any case, if two taxa of species rank meet each other in some areas, they should retain their specific characters in song and ecology. In addition, I made a complementary study of some museum specimens in order to judge whether their morphological variation in the contact area is compatible with the results from the song study.

Differences in song

The songs of *abietinus* (= *collybita*) and *tristis* have been described in many publications, of which the most important include Cramp (1992), Glutz & Bauer (1991) and Martens & Meincke (1989).

The song of *abietinus* is simple and rhythmic. Similar syllables follow each other with little variation. Essentially the song consists of alternately higher and lower pitched syllables, but in other respects they are rather similar. This alternation is a distinct feature of the song, and has contributed to the species name in many languages, including Finnish, German and English. The frequency range in both styles of note is still rather similar, and the difference in the impression of the pitch is due to the point in the syllable where the rapid drop in frequency stops and even stays more or less the same for a moment, or is dependent on how strong and rising the end of the note is. Typical notes of *abietinus*-song are invariably descending in frequency, but at the end there is often a short rise or several short rises and falls. Examples of typical *abietinus* song are presented in figs 1-3. The phrases often consist of slightly more than ten notes, but they can sometimes continue for much longer.

The song of *tristis* is distinctly different: much faster, more flowing and floating, not as rhythmical. To the human ear, many notes are less simple and distinctly more disyllabic. Martens & Meincke (1989) found the following distinct average differences: the individual notes of *tristis* are shorter, and the pauses between them are also shorter, the highest frequency is lower and the bandwidth smaller. The song essentially consists of alternately ascending and descending syllables. There are many exceptions to the rhythm, for example two rising notes can be consecutive occasionally, but not frequently. The descending syllables are in theory rather similar to the elements of *abietinus* song (but shorter and with a smaller bandwidth), and they can also include a rising end part. This ascending end to a syllable is similar to a separate ascending syllable and can replace one. Because the song is faster, the phrases include more notes than in *abietinus*. Examples of typical *tristis* – song are presented in figs 4-5.

Differences in appearance

Abietinus and *tristis* are quite similar to each other in appearance, but normally are clearly different – we have to remember that there are several taxa in the genus *Phylloscopus*, which look very similar, but are still regarded as separate species. Identification features are described in e.g. Cramp (1992), Dean & Svensson (2005), Glutz & Bauer (1991) and Svensson (1992), and they are not extensively repeated here. Generally, *tristis* is more strongly brown or buff, less green and yellow than *abietinus*. In addition, *tristis* is somewhat smaller. The differences in the appearance of *abietinus* and *tristis* are clearer than between the very similar *collybita* and *ibericus*. During breeding in May-July, adult Chiffchaffs are in a quite worn plumage, and the colour

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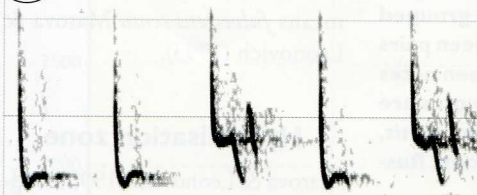


Figure 1. Common Chiffchaff *Phylloscopus collybita abietinus* 1.5 seconds of song. Three *chaff* and two *chiff* notes. The latter with a long, curving tail in this case. Such notes are very typical. Sonkajärvi, Pohjois-Savo, Finland, 18 May 2003.

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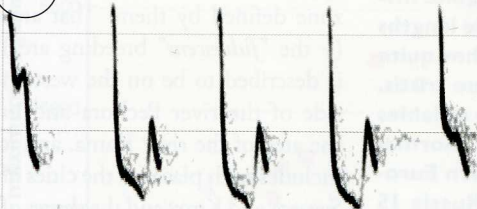


Figure 2. Common Chiffchaff *Phylloscopus collybita abietinus* 1.5 seconds of song. Three *chaff* and two *chiff* notes. In this individual, the *chaff* notes have a long curving tail. Note that the *abietinus* notes start from higher up on the frequency axis than the corresponding notes of *tristis*. Spithami, Läänemaa, Estonia, 1 May 2004.

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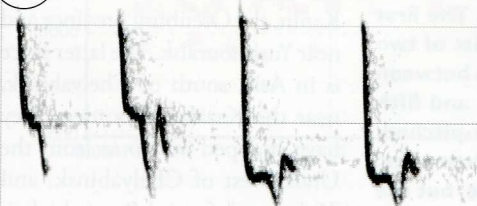


Figure 3. Common Chiffchaff *Phylloscopus collybita abietinus* 1.5 seconds of song. Two *chiff* and two *chaff* notes. The *chiff* notes are quite different from each other in this case. Kalvola, Häme, Finland, 3 June 2004.

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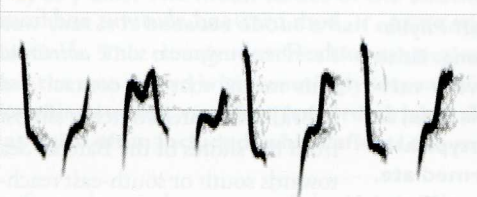


Figure 4. Siberian Chiffchaff *Phylloscopus collybita tristis* 1.5 seconds of song. Note the typical structure of the *tristis* song: the ascending and descending notes are alternating. Quite often there are odd notes in between, the third one in this example. Because its end is higher than its beginning, it became classified as ascending, although it probably corresponds to both the ascending and descending note. Polarnyi Ural, Komi, Russia 25 June 2006.

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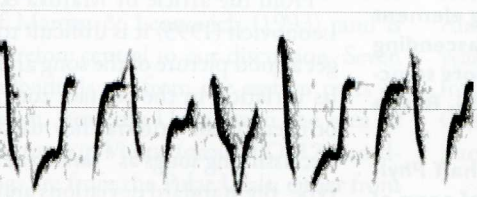


Figure 5. Siberian Chiffchaff *Phylloscopus collybita tristis* 1.5 seconds of song. An additional example of *tristis* song. It includes a syllable which first goes down, then up. But this syllable is still quite distinct from the corresponding syllables of *abietinus*. Polarnyi Ural, Komi, Russia 25 June 2006.

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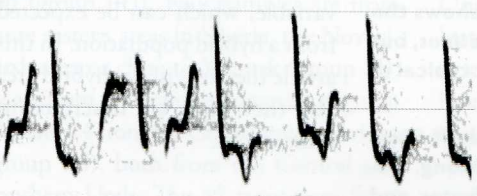


Figure 6. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. The first five notes are quite *tristis*-like, but the following four resemble *abietinus*. To the ear the song really sounded like both types of song alternating. Syktyvkar, Komi, Russia 16 June 2004.

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Figure 7. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. Between the *tristis*-like notes there is one *abietinus*-like note. This note is easy to hear. Syktyvkar, Komi, Russia 14 June 2004.

differences are smaller and more difficult to interpret than in fresh plumage during autumn. Especially, *abietinus* is less green and yellow, because those colours wear and bleach. *Tristis* in worn plumage may be significantly paler and greyer brown; the warm hue may be quite slight but an element of brown generally remains evident. Also, the colour of the breast sides is not so intense. In some, the greater coverts, primary-coverts and the edges of the primaries may lack greenish altogether.

Fulvescens

The name *fulvescens* is commonly thought to refer to an interbreeding population of *tristis* and *abietinus*. Marova & Leonovich (1993) are especially explicit in that opinion. They also describe the song of *fulvescens* based on heard and sound-recorded individuals from the contact area. If *fulvescens* is really defined that way, it is hardly possible to regard it as a geographical subspecies any more than the hybrids between Hooded *Corvus corone cornix* and Carrion Crows *C. c. corone* from their contact zone.

The original description of *fulvescens* by Severtzov is based on the colour of the birds, and the material is from the migration areas (Dean & Svensson 2005). Based on that, *fulvescens* has been defined as *tristis* with some *abietinus* characters, for example some indistinct yellow streaks on the underparts (e.g. Svensson 1992, Dean & Svensson 2005). According to many sources, the range of *fulvescens* stretches from the Urals to Yenisei, which means that it consists of the western part of the *tristis* breeding area. However, the area of sympatry and hybridisation, with mixed singers, is much more to the west, in Europe (Marova & Leonovich 1993, this study). If *fulvescens* as a whole is an intergrade population, then to the east of the Urals it must result from limited, secondary gene flow. Martens & Meincke (1989) studied the song of *tristis* in a large area from Sverdlovsk province (Middle Urals) eastwards to Lake Baikal, and they did not note any geographical variation – that means that at least all the northern Asian Chiffchaffs will sing like *tristis*. Although it seems reasonable to suppose that the characters of *fulvescens* derive from a genetic intermingling with western Chiffchaffs, it is not sensible to equate the taxon with the birds from the contact zone. In this article, birds from the contact zone are

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Figure 8. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. The song is *tristis* – like, but the notes are grouped pairwise so that the intervals between pairs are longer than the intervals between notes of the same pair. In addition, the notes are very variable. This song sounds like *tristis*, but is more rhythmic. Syktyvkar, Komi, Russia 15 June 2004.

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Figure 9. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. Quite *tristis*-like, but to the ear the variable lengths of note intervals make the rhythm quite different from the song of a true *tristis*. Although there are no *abietinus* – syllables here, the song still resembles a "normal Chiffchaff" to the ear of a Western European birder. Syktyvkar, Komi, Russia 15 June 2004.

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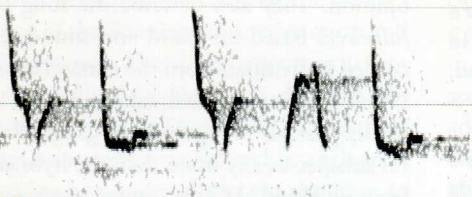


Figure 10. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. The first and second "notes" (which consist of two different notes) are intermediate between *tristis* and *abietinus*. The second and fifth are quite *abietinus*-like, but lower-pitched, and the fourth (pair of notes) is *tristis* – like. When heard, quite *abietinus* – like, but the *tristis* – type pair of notes sound different with an inhaling tone. Syktyvkar, Komi, Russia 13 June 2002.

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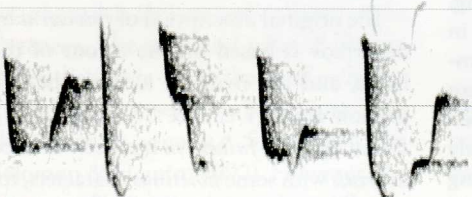


Figure 11. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. Both *tristis*- and *abietinus* – notes and very variable. It should be noted that in this case, as normal, the variable notes are not typical of either taxon, but somewhat intermediate. *Abietinus*-like notes are "compressed" and *tristis*-like ones "combined" or "grouped". For example, quite often the *tristis* – like elements have the initial descending element much higher than the following ascending one, which is a step towards the note structure of *abietinus*. Syktyvkar, Komi, Russia 15 June 2002.

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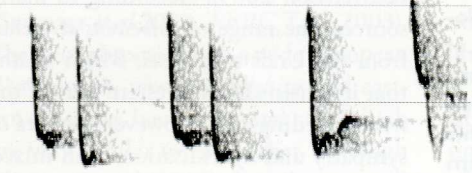


Figure 12. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song of a mixed singer. An example of the great variation of the song of Southern Komi birds. As this spectrogram also shows the song indeed sounds quite like *abietinus*, but the fast, paired elements are not typical of it. Komi, Russia 15 June 2002.

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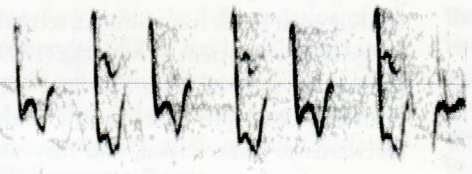


Figure 13. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. Resembles *abietinus* more, but is faster and the individual notes start lower. The last note is ascending in the *tristis* – style. Komi, Russia 15 June 2002.

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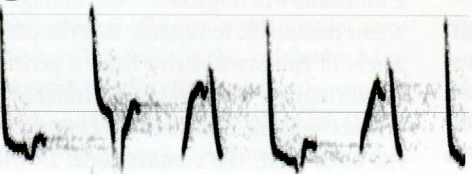


Figure 14. Mixed singing Chiffchaff *Phylloscopus collybita*. 1.5 seconds of song. A good example of a bird with notes from both song types. The first is very *abietinus* – like and the others are either *tristis* – like or intermediate. Komi, Russia 13 June 2002.

sometimes referred to in quotation marks as "*fulvescens*", which means *fulvescens sensu* Marova & Leonovich (1993).

Hybridisation zone

Marova & Leonovich (1993) studied some characters of the song and appearance in the hybridisation zone defined by them. That area (= the "*fulvescens*" breeding area) is described to be on the western side of the river Pechora and in the area of the river Kama, and it includes such places as the cities of Samara and Kirov and the shores of Mezen bay. Their "*fulvescens*" song material is from Mordino (Komi), Kanin, the Orenburg province and near Yushnouralsk. The latter place is in Asia, south of Chelyabinsk, near the Kazakstan border. They have mapped *abietinus* from the Urals, west of Chelyabinsk, and "*fulvescens*" from Mias (which is slightly westwards from Chelyabinsk). From the Ufa area there are both *tristis* and *abietinus*, and from the Orenburg area, some *abietinus*. This means that the contact and hybridisation area stretches almost from the shores of the Barents Sea towards south or south-east reaching southern parts of the Ural mountains.

From the article by Marova & Leonovich (1993) it is difficult to get a good picture of the song and its variation in the contact zone, or even of the criteria they used in classifying songs as "*fulvescens*" type. Big standard deviations and measurement intervals suggest that their "*fulvescens*" song is very variable, which can be expected from a hybrid population. In this article the birds in the hybrid area and their song are described in more detail.

Material

The study of song is based on 195 sound recordings of territorial song, originating from the breeding areas. However, in many cases the social situation of the individual recorded birds remained unclear. 29 of the recorded individuals

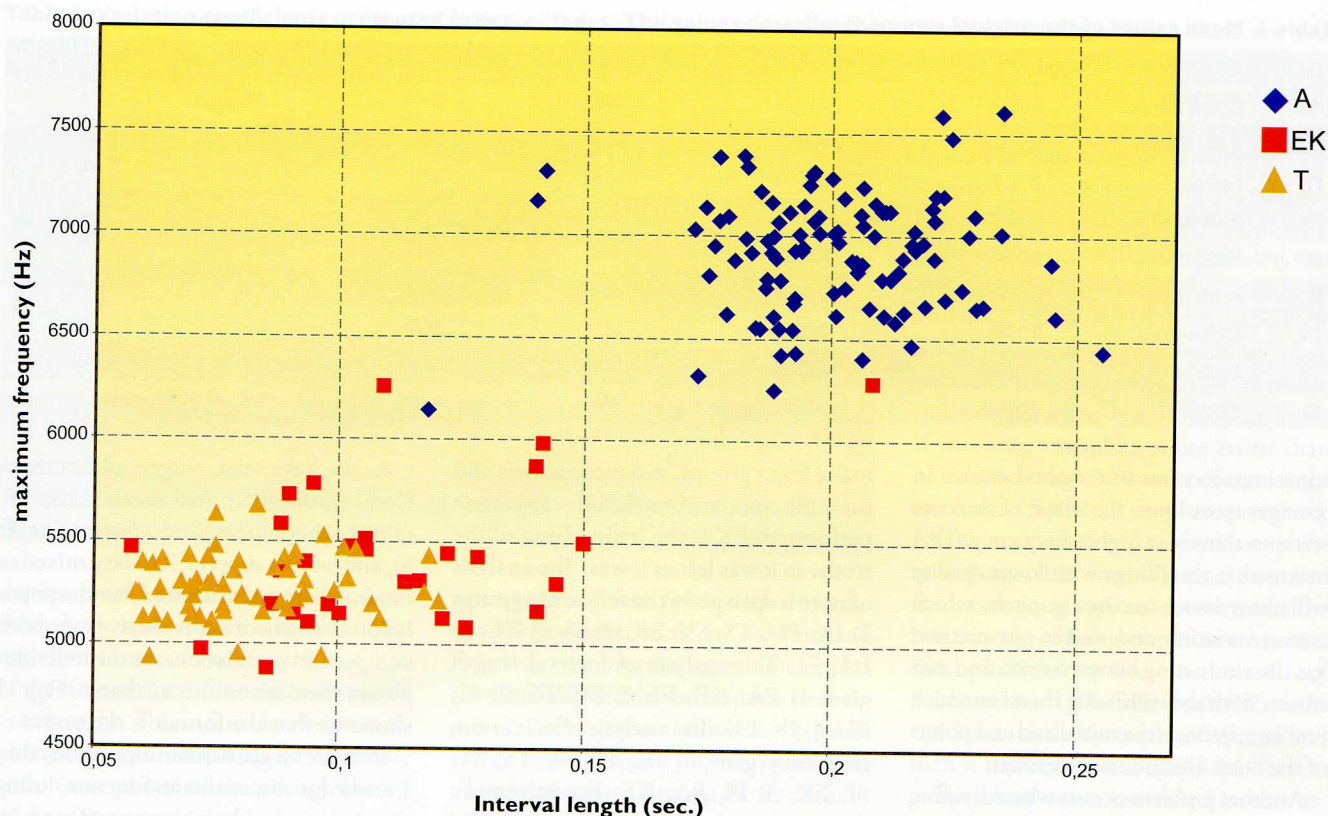


Figure 15. Individuals of groups T, EK and A. Scatterplot with note interval length (sec) as x axis and maximum frequency (Hz) as y axis. The mean values of the Southern Komi sample (EK) are between those of T and A, and this figure helps to show that it is because about a half of EK individuals sing like tristis, almost half are mixed singers and one has a song like abietinus. This closely matches the subjective feeling one gets when listening to these birds in the field. It should be noted that the one A bird with seemingly intermediate song was not a mixed singer similar to the EK birds. It was a bird singing like abietinus but very fast (recorded 1 July 2003 in Tampere, Finland). Among the normal notes a pair of very fast notes was quite often included, which affects the mean values of the song. There were no ascending notes.

are from the southern parts of the Komi Republic, close to Syktyvkar (group EK). This material is from the "*fulvescens*" – area of Marova & Leonovich (1993), and is therefore central to our discussion. Seven individuals are from the eastern parts of Komi, near the Urals, from the area of the town of Vuktyl (group IK). 12 recordings are from the Polar Urals, either from Komi (Inta or Polarny Ural), or Salekhard, Yamalo-Nenets, on the banks of the river Ob (group PU). Four samples are from more eastern areas in Siberia, the Novosibirsk area or close to Yakutsk (group SI). 22 are from the Sverdlovsk province (group SV) and 14 from the Chelyabinsk province (group TS), both from the Central and Southern Urals. The 45 recordings from Russian Karelia and Finland form group FI, and the 58 from the the Baltic states group BA. The latter are mostly from Estonia, but some are from Lithuania. For comparison, I included three recordings from Austria and two from the western parts of Bulgaria (group KE). The breeding birds there are of the nominate subspecies,

based on the distribution areas as described in the literature (Cramp 1992). Most of the recordings are recorded by the author or Annika Forsten, and recorded between the years 2001 and 2007. Two from Siberia are from Mild (1987) and two are recorded by Christoph Zöckler and published on the internet (www.club300.de).

Methods

One complete and typical phrase was selected from the recording and midway through the phrase ten notes and note intervals were measured. Recordings with insufficient quality were not used (if the spectrogram was not clear enough for measuring). In addition, a couple of *abietinus* had to be left out, because none of their phrases were long enough. The first or several of the first notes of a phrase are often somewhat different from the others, with weaker introductory notes, and that was the reason why I did not start the measurements from the beginning of the phrase. For the measured variables I chose

those which Martens & Meincke (1989) had noted as differentiating between the taxa: the highest and lowest pitches of the notes, the initial and terminal pitches of the note, the length of the notes, and the interval between the succeeding notes. This means that, for every individual, 70 separate measurements were written down. The measurements were done with the program Syrinx, version 2.6h, (c) John Burt 1995–2006, www.syrinxpc.com. The measurements were taken from recordings of sampling frequency 22050 Hz. When measuring from the frequency axis, the spectrogram was written with FFT (Fast Fourier Transform) length 2048, and for the time axis, FFT length 256 was used.

The most difficult problem when measuring *abietinus* -type song is the highest pitch of the note. The highest pitch always occurs at the beginning, and it is not very well defined. I measured it from the place where the clear downward shape starts to become clear from the background. That means that the amplitude of the recording in relation to the background noise has

Table 1. Mean values of the original groups.

Group	Area	Note length sec.	Note interval sec.	Max frequency Hz	Min frequency Hz	Descending notes	Sample size
KE	Central Europe	0.0944	0.2274	6983	3548	10	5
BA	Baltic States	0.1270	0.2019	6954	3257	10	57
FI	Finland	0.1287	0.1996	6870	3259	10	45
EK	Southern Komi	0.0944	0.1108	5451	3391	6.4	29
IK	Eastern Komi	0.0841	0.0856	5169	3377	5.3	7
PU	Arctic Urals	0.0871	0.0750	5216	3489	4.9	12
SV	Middle-Urals	0.0882	0.0842	5335	3463	5.5	22
TS	Southern Urals	0.0874	0.0858	5290	3434	5.8	14
SI	Siberia	0.0906	0.0657	5315	3683	5.5	4

some impact on measurements because, in stronger recordings, the shape of the note starts to show at a higher frequency. That means that recordings with lower quality will show lower maximum pitch, which creates variation and makes our method less discriminating between *tristis* and *abietinus*. With the *tristis* song there is no such problem, because the initial and end points of the notes are quite well defined.

Another problem occurs when dividing phrases into notes, which, of course, has great impact on the length of the notes and intervals between them. Dividing is quite straightforward in *abietinus*, although in some cases a note seemed almost to be cut in two before its end part (this means that the amplitude was at its lowest in this part of the note). But it was easy to judge which was the end part of the note, and count this as belonging to the same note. In *tristis* song there is typically a descending note with an ascending note succeeding, but there are also some notes with both a descending and an ascending part. These two cases were not always easy to separate. When trying to assess this, the spectrogram was observed with different FFT-values, and the parts were counted as one note, if in some spectrogram parameters, a visible bridge joined them. However, there were some borderline cases.

Song

Basic statistics from the original groups are presented in Table 1. In order to

make fewer groups, variance analysis and multiple comparisons (LSD) – tests were performed. EK is the main object of the study, so it was left as it was. The analysis of note length gives the following groups 1) IK, PU, TS, SV, EK; 2) SI; 3) KE; 4) BA, FI. The analysis of interval length gives 1) BA, KE, FI; 2) SV, TS; 3) SI, PU; 4) IK, EK. The analysis of maximum frequency gives 1) IK, PU; 2) TS, SV, SI, EK; 3) FI, BA, KE. For minimum frequencies, the variance homogeneity condition does not get fulfilled.

According to these results, we can at once combine the groups FI (=Finland) and BA (=Baltic states), because they are in the same groupings every time. Let's call that new group A (= *abietinus*). In addition, we can combine the groups from the Middle and Southern Urals TS and SV to a new group T (= *tristis*). Birds from Siberia (SI) and the Arctic Urals (PU) are clearly closely related to T, and they will be combined too. Those from Eastern Komi are not so clear, and they are quite close to the group EK. But because of the amount of descending notes, I feel confident in combining it with group T. Group KE will be left out from further analysis after noting that using these methods and this material, I could not find any differences between Northern European *abietinus* and Central European *collybita*. Statistics of the new groups are presented in table 2.

In fig. 15 individuals are plotted against note interval length and maximum frequency.

As we have seen, singers of Southern Komi (group EK), had mean values between groups *tristis* and *abietinus* (table 3), and we can suppose it to be a mixed or intermediate population (either the population consists of individuals from both comparison populations, or the individuals are themselves intermediate). Fig. 15 shows us that the former is the case.

In order to get further support for this, I created a discriminant function (using discriminant analysis to groups T and A). I use the highest frequency of the notes (KT), note interval length (VP) and descending note amount (LT). The function will be $ta = 1,58 * LT - 0,27 * VP + 0,93 * KT$. The ta value separates groups T and A completely so that the highest value for group T, T(max) is 15.9 and the lowest value of group A, A(min) is 21.1. Five birds from group EK have values in the exclusion zone between these values. One EK-birds are placed over A(min) and the remaining 23 individuals under T(max). But from the 16 highest-positioned individuals under T(max) eight (50%) are from group EK. There are still several EK-birds even among those with lowest ta values. The population EK still really seems to be quite *tristis* – like, but includes a sizable subgroup with variable amount of *abietinus* characters (more than third, less than half).

Variability within a verse

The song verses of the Southern Komi birds (group EK) have a more variable

Table 2. Mean values of the combined groups.

Group	Taxon	Note length sec.	Note interval sec.	Max frequency Hz	Min frequency Hz	Descending notes	Sample size
A	<i>abietinus</i>	0.1277	0.2009	6917	3258	10	102
EK	" <i>fulvescens</i> "	0.0944	0.1108	5451	3391	6.4	29
T	<i>tristis</i>	0.0876	0.0824	5280	3460	5.4	59

Table 3. Variation coefficients presented in percentages. The values describe the variability within a verse of the sampled songs. * - this outlier is from the same individual mentioned in the caption for Fig. 14.

Group	Note length sec.	Note interval length sec.	Sample size
A	3-37%. avg. 19%	2-23(51)%. avg. 10%	102
EK	13-50%. avg. 34%	14-74%. avg. 49%	29
T	12-51%. avg. 31%	26-72%. avg. 45%	59

Table 4. Variability of note shapes.

Group	Amount of descending notes	Sample size
A	10	102
EK	4-10. avg. 6.4. st.dev. 1.889	29
T	4-7. avg. 5.4. st.dev. 0.776	59

rhythm than those of other groups. I calculated a variation coefficient (standard deviation / mean value) for the variables of the time axis, *i.e.* for note interval and note lengths. This meant that I was comparing different individuals for variability within one phrase of their song. The results are presented in table 3.

Note shape

I defined the descending note as one with the final frequency lower than the initial frequency, otherwise the note is ascending. In table 4 the number of descending notes inside a phrase are presented. There were no ascending notes in any of the birds in group A, so the number of descending notes is 10 for all of them. In contrast, in true *tristis* song, almost half of the notes are ascending. Among group EK, six individuals had 8, 9 or 10 descending notes, which means that they were outside the variation of group T. The great variability of EK individuals also shows in this respect.

Colouration

I studied 19 Chiffchaff skins from the Komi Republic or the Kirov Oblast, mostly in the collection of the Moscow University Zoological Museum. Most of them were collected between late April and late June, but six birds from the Kirov area were from September. The material is small, but it is still possible to get some impression of what the birds inside the contact zone usually look like. The birds from late spring and summer are generally quite similar to those from Eastern Siberia, although probably a trifle lighter on

average. In any case, *fulvescens* features are not very evident. Some are so worn and faded that the brown tinge on the upperparts is reduced and the bird has become greyer. Others have a more clearly green rump, more greenish on the mantle and whiter underparts. Among the six autumn birds there are two which resemble *abietinus*, two which are quite like eastern *tristis* and two are in-between (slight greenish bars on the crown, some yellowish bars on the underparts). As stated earlier, the sample is too small and uneven, but it is compatible with the results of song analysis: there is an intermediate population in the area, and many of its individuals are quite *tristis*-like.

Discussion

The *tristis* and *abietinus* subspecies of Chiffchaff have songs which are quite different from each other. However, there is an area where a sizeable proportion of the individuals sing intermediate songs. The city of Syktyvkar, in the southern Komi Republic is a part of this area. The material from this area was sound recorded 11-16 June 2002 and 14-16 June 2004. One of the recordings is from the area of Ust-Kulom, about 150 km east of Syktyvkar, the rest are recorded inside an 80 km radius from the city. In this area, there are many individuals which sing like normal *tristis*, and some which sing like *abietinus* (only one in the sample). Almost half of the individuals have mixed properties of both song types.

Even when heard by the human ear, many of the songs are clearly intermediate. They may appear to be in principle like *tristis*, but with some *abietinus*-type

sharper notes, and when there are even just two of them in succession, the flowing rhythm of *tristis* is disrupted. Many of the intermediate songs closest to true *tristis* are slightly more rhythmic. The impression may be of uneven rhythm and unease or nervousness. The song of other individuals is quite like *abietinus*, but now and then there is a *tristis*-like ascending and descending pair of notes embedded. Those pairs of notes may sound very fast, pure and inhaling. In addition, there are individuals, where it is difficult to decide if the song resembles more *tristis* than *abietinus*. In figs 7-14 some of the southern Komi Chiffchaff songs are presented. I have not heard, in the field, or in the recordings, that one individual switched from one song type to another, but the mixed song of EK-group is intermediate in its phrase structure.

I have heard Chiffchaff calls in southern Komi only a couple of times, and then it has been *tristis*-like.

The observation presented in this article concerning the placement of the mixed song area, is compatible with the results of Marova & Leonovich (1993). The breadth of the mixed singing area cannot be estimated from the material I have, but probably Syktyvkar is in the eastern part of it, because most of the songs more or less resemble *tristis*.

In the Urals proper Chiffchaffs sing like *tristis*; this is true for Arctic, Northern and Middle Urals.

Intermediate song does not prove gene flow between *tristis* and *abietinus* as such, because the song of oscine passerines is, for a considerable part, learned. But the intermediate singers from the *ibericus* and *collybita* hybridization area were mainly genetical hybrids (Bensch *et al* 2002). In any case the fact that there is a large contact zone where a large proportion of the birds sing an intermediate song proves that the taxa do not meet each other as full biological species should. More information could be discovered by studying the reactions of the birds to songs of the other taxa. I have not really done such tests, but to one bird on territory near Syktyvkar I played Chiffchaff song from Roché (1990), which probably had been recorded in Western Europe. The bird's ta-value was 12.8, that is quite *tristis*-like. As soon as the tape-recording was started, the bird stopped singing, dropped down towards the player and flew low over it several times. This is undeniably a strong



Photo 1. Siberian Chiffchaff *Phylloscopus collybita tristis*. A fresh autumn bird. The crown and mantle are uniform in colour, drab-brown. This individual shows some olive on the scapulars. The edges of the greater coverts, primary coverts and remiges are only slightly greenish. The supercilium and a variable area on the breast are buffish, somewhat ochrous. Other individuals are more widely warm-brown underneath, sometimes almost the whole of the underparts are of that colour. Wing length 56.5 mm. © Antero Lindholm 30 September 2007 Espoo, Uusimaa, Finland.

reaction, and is similar to how a Finnish Chiffchaff reacts normally to hearing its own song. However, according to Martens & Meincke (1989) the reactions of western Chiffchaffs to *tristis* song are very weak.

More detailed information about the gene flow between *abietinus* and *tristis* and the width of the hybridisation zone will in any case need further study. In Price (2008), appendix 15.1 there is a list of better-studied avian hybrid zones. The following properties are listed, if known: the length and the width of the zone, habitat differences between the parental types, mitochondrial-DNA distances between the parental forms, the amount of assortative mating, the fraction of birds with hybrid phenotypes and the change in the position of the zone. All this should be studied in order to make the zone adequately known.

As mentioned previously, the hybridisation zone of *ibericus* and *collybita* in the Pyrenees has been closely studied. The contact zone between *tristis* and *abietinus* is much less studied and precise comparisons cannot be made, but a few comments still follow. The contact zone in the Pyrenees is 20 km wide and c. 70 km long (e.g. Helbig *et al.* 2001). The

contact zone in the Urals is as long as 1500 km according to Marova & Leonovich (1993). The width is difficult to assess with current information, but it is in any case of an entirely different class than the contact zone in the Pyrenees.

Also note that in the Pyrenees less than 10% of the Chiffchaffs are intermediate singers and about 10% hybrids (e.g. Bensch *et al.* 2002). It looks like *tristis* is a much less distinctly separated taxon than *ibericus*.



Photo 2. Common Chiffchaff *Phylloscopus collybita abietinus*. A fresh autumn bird. Typical greyish olive-brown and quite uniform mantle – scapular – area. The crown slightly less green than the mantle and the rump is a slightly paler than both. This bird called in the hand with a typical *abietinus* call. Wing length 63 mm, © Antero Lindholm 30 September 2007 Espoo, Uusimaa, Finland.



Photo 3. Common Chiffchaff *Phylloscopus collybita abietinus*. A territorial male in late spring. Quite similar to autumn birds (cf. Photo 2), but more worn and the tones on the upperparts have bleached. Some other individuals are still more brownish – grey on the upperparts. Wing length 66 mm © Annika Forsten 21 May 2005 Kangasala, Häme, Finland.



Photo 4. A Chiffchaff *Phylloscopus collybita*. This individual may well be from the intermediate song zone (or possibly from the western parts of the *tristis* song area). Quite similar to the bird in Photo 1, but it is slightly olive-toned on the mantle, has slightly more prominent olive colour on the scapulars and the edges to the tertials, remiges and rectrices. A quite pronounced rusty-buff suffusion on the ear-coverts would be good for *tristis*. This bird was not heard calling. Wing length 61 mm. © Annika Forsten 29 September 2004 Lågskär, Åland Islands, Finland.

Acknowledgments

Thanks to Alan Dean, Annika Forsten, Aleksi Lehtikoinen, Lars Svensson and the staff of the Natural History Museum of Moscow for help in my studies or in planning this article. Thanks are also due to the various groups of birders who have travelled with me to different places in the Urals.

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