Scientific Research Publishing

Journal of Sensor Technology, 2026, 16(2), 13-27
https://www.scirp.org/journal/jst
ISSN Online: 2161-1238
ISSN Print: 2161-122X

Feature Identification in a Blackbird Song

Giancarlo Tiziano Tomezzoli

Faculté de Lettres et Sciences Humaines, Université de la Bretagne Occidentale, Brest, France
Email: gt219490@gmail.com

How to cite this paper: Tomezzoli, G.T. (2026) Feature Identification in a Blackbird Song. *Journal of Sensor Technology*, **16**, 13-27.
https://doi.org/10.4236/jst.2026.162002

Received: June 6, 2026
Accepted: June 27, 2026
Published: June 30, 2026

Abstract

In this article, my encounters with blackbirds, which motivated me to study the blackbird's song, are reviewed, and the state of knowledge about blackbirds is recalled. The article is based on the Voix 004 - Voix 013 song samples of a blackbird's song acquired by means of the application Enregistreur Vocal installed on a Galaxy S20 FE 5G phone. The sample analysis has been performed by means of the program Audacity 3.7.8. The waveform diagrams, the spectrograms, and the Fourier analysis of the samples are presented and commented upon. The Audacity instructions used in the analysis are included in the article.

Keywords

Blackbird, Turdus Merula, Song, Samples, Galaxy S20, Audacity

1. Introduction

In the past, I occasionally encountered blackbirds. The first time, a long time ago, my son told me that a beast had gone under the house heater. I carefully extracted what turned out to be a young blackbird, which I released onto the grass in the garden. A couple of blackbirds, male and female, got down onto the grass, lifted him up, and laid him down on a nearby tree. Surprisingly, they immediately returned to the grass in front of me. Naively, I thought they had come to thank me for freeing their young blackbird, but now I think that they came back to show me the limit of their territory, with the implicit invitation not to cross it.

Just in the month of April 2026, while going to the Landerneau (FR) rail station early in the morning, I noticed the song of a blackbird. The song was composed of song sequences separated by silent intervals. Each sequence included a flute-like melodic phrase followed by a chirping appendix. During the silent intervals, two similar sequences occurred, coming from two other nearby blackbirds. It was something like a three-way remote dialogue.

On 29th May 2026, I was sitting on the balcony of my apartment in Verona (IT), looking to the west, enjoying the light of the setting sun, when a common blackbird landed on the balcony railing (Figure 1) directly behind me. Heedless of my presence on the balcony, he started performing a song that caught my attention. Again, each sequence was followed by a silent interval, allowing the understanding of a similar sequence from another nearby blackbird. In this case, it was a two-way remote dialogue. Curious to learn more about blackbirds, and having my phone with me, I decided to record portions of the song and to start research about the blackbirds and the significance of their song. But which song features is it possible to identify in the song of this blackbird?

(1) (2)

Figure 1. The blackbird on the balcony railing: (1) Panoramic vision, (2) Detailed vision.

2. Background

The blackbird was described by Linnaeus in 1758 under the name of "Turdus merula". It belongs to the genus Turdus, a group of the Turdidae family. This genus includes about 65 species of blackbirds. Normally, an adult blackbird has a rounded head, a 25 cm long body, a 35 cm wingspan, and spreads the aforementioned characteristic song.

An adult male has an orange-yellow beak adapted to an omnivorous alimentation, a yellow- orange eye-ring, entirely black plumage, and dark brown or black legs adapted for jumping and/or walking on the ground.

An adult female has brown plumage, with a paler throat and breast. Her beak is brown and may become yellow with age. The eye-ring is less pronounced than that of a male. Normally, she is slightly smaller than a male.

The blackbird species are endothermic and exhibit bilateral symmetry.

The blackbird inhabits Europe, North Africa, and temperate Asia. It lives in forests, agricultural areas, and urban areas. In urban environments, it inhabits parks and gardens and can be found in hedgerows, orchards, meadows, and, in general, where the vegetation is dense. It can live up to an altitude of approximately 2300 meters. In the wild, it can live up to about 2.4 years. Some blackbird groups undertake seasonal migrations, often during the night.

The adults are normally organized in territorial pairs during the breeding and nesting season. Outside this season, several individuals may share the same area for feeding or roosting. In rural areas, parks, and gardens, the local density can reach up to about seven pairs per ha; in cities, it can reach one pair in 0.1 - 0.3 ha, and in forests, one pair per 0.2 - 0.5 ha.

The courtship is performed by the male, maintaining the beak open and performing short oblique runs, tilting the head and emitting strangled sounds. The female remains motionless during the courtship and indicates her acceptance of the male by simultaneously raising the head and the tail, which allows copulation. Certain males try to pair with females who already have a partner.

The nest is in the form of a small cup and is built by the female. It is made of herbs, twigs, moss, and vegetable roots. The nest is usually located in a shrub or tree, or against a wall.

The incubation normally lasts between 12 and 14 days. The female lays between two and six blue-green eggs with red-brown speckles. The chicks are born naked and blind. The two parents mainly supply them with insects and larvae [1].

The Trivers-Willard hypothesis suggests that, according to its own health condition and the alimentation resources of the occupied area, the female may adjust the sex of the chicks [2].

The young have brown plumage, with the darkest plumage in the males. The juvenile plumage is retained until the first moult. After about one year, the males gradually acquire the black plumage, the orange-yellow beak, and the yellow eye ring.

The marking and defence of territorial boundaries is based on visual and behavioural aptitudes such as short runs, body tilts, and song. A song has pitch and volume modulated according to the situation and the surrounding soundscape. Other than song, the blackbird produces a variety of calls and repetitive alarms when a predator, for example, a cat or a bird of prey, is identified.

The blackbird eats mainly terrestrial invertebrates and, depending on the season, it can eat small fruits and vertebrates. It occupies an important position as a consumer of fruits and grains (primary role) and of insects and worms (secondary role). Its omnivorous diet allows it to act as a seed disperser, especially by the regurgitation of seeds, and as a controller of the populations of beetles, caterpillars, and a variety of other arthropods [1] [3].

[4] studied the song of Turdus merula in South Oxfordshire, in the period 8th March - 9th June 1957. He recognized:

- basic phrases: the simplest forms of phrases recorded in the first week;
- basic variants: slightly modified versions of the basic phases;

- developed forms: new phrases formed principally by the combination of parts extracted from basic phrases and basic variants;
- compound phrases: relatively long phrases, normally resulting from the combination of two or more entire basic phrases or variants;
- intermediate forms: transitions between basic phrases and developed forms;
- terminal decorations: sounds such as ticks and squawks not resembling pure notes in a phrase;
- series: recurring sequences of phrases within which the individual phrases were maintained in a specific order, sometimes identified as "sentences";
- counter singings: answers of one blackbird to another with the same or closely similar phrases;
- antiphonal singings: immediate completion by one blackbird of a phrase left unfinished by another blackbird, where the phrase, or a part of it, is common to the repertoires of both;
- communal singing: the unison singing by two blackbirds of a phrase common to both; the second blackbird starts to sing after the first, so that only part of the phrase is a duet.

He reminds that the juvenile blackbird learns phrases from its male parent and from other neighbouring blackbirds and vice versa; therefore, imitation is responsible for much of the blackbird's spring songs. The varied responses to the phrases of other blackbirds suggest that some selection means were used. He confirmed direct answers with similar phrases. The analysis of collective singing proposes that each blackbird knows the phrases sufficiently to join them at any note. This may indicate that a blackbird has a precognition of the following sound or sounds in a phrase. He affirms that it is conceivable that, together with functional aspects, the blackbird's songs have traces of an aesthetic activity.

[5] proposes, for the visualization of the blackbird song, the waveform diagram: a diagram of the variation of the waveform amplitude over time, and the sonogram: a diagram of the variation of the frequency over time. He distinguishes the "cesura": a silent zone, and the unit or motif: a song event. A unit consists of a "flute" portion and a "trill" portion. The "flute" portion represents a moment of the unit. It is characterized by an ascendant phase towards a high-pitched tone and a descendant phase towards a low-pitched tone. It can be simple: without short cesurae, or composed: with short cesurae. Furthermore, it is terminated by the "trill" portion or "recurrent formula" or stylistic trait or rhythmic clause. A moment can be repeated, with or without variations, inside a motif.

[6] considered the variation in the blackbirds' song in breeding territories on the Melbourne University campus and Ballarat University campus, located about 25 km apart. Principal components analysis (PCA) and discriminant analysis (DA) were undertaken on 61 variables relating to 13 aspects of a phrase for a total of 400 recorded phrases: 100 phrases per male blackbird. They found evidence of phrase variability, with greater variation in the middle of a phrase. The beginning of each phrase was normally louder and longer to gain the attention of possible

listeners. Individual and site-specific information was in the middle of the phrase. The species signature was at the end of the phrase.

[7] considered a blackbird population of about 80 breeding pairs on the Helgoland island (D). They observed that the full songs of blackbirds are organized into phrases or "Strophen" about 2 s long, separated by silent intervals of about 3 s. A typical blackbird's phrase starts with a long-ranging whistle part consisting of 3 - 5 low frequency elements between 1.5 kHz and 3 kHz, and ends with a twitter part comprising a more variable number of elements with an average higher frequency of about 10 kHz and a broader frequency range. Complete songs are only occasionally repeated, but there are fixed sequences of elements or "motifs" that are always sung in the same order. They concluded that a territory holder blackbird does not use the song of an intruder blackbird to evaluate the fighting capability of the intruder. It perceives the song as the risk of losing part of its territory or seeing its female engage in an extra-pair relation with the intruder.

[8] considered the same blackbird population as [7]. They observed that older blackbirds tended to have larger song repertoires than one-year-old blackbirds, but there was considerable overlap between the two groups. Body size and age suggest that repertoire song size may constitute a signal of the overall male quality in blackbirds.

[9] reported that blackbirds are normally active during the day, with a tendency, in urban environments, because of artificial lighting pollution, to extend their activity into the sunrise and sunset and to anticipate the seasonal start of the reproduction period. The reduction of the melatonin hormone, secreted by the pineal gland, caused by artificial lighting pollution, appears to affect blackbird night and day activities and seasonal rhythms. Melatonin secretion is active at night and suppressed during the day. It is able to synchronize the circadian cycle of the blackbird with the modified duration of day and night.

[10] investigated the blackbird song along the urban gradient of anthropogenic noise and artificial night light from the city center of Leipzig (D) to a nearby urban forest. They found that blackbirds in the city center started their dawn songs up to 5 hours earlier than those in semi-natural habitats. Traffic noise shifted the dawn song into the night, while cloudy and cold weather delayed the onset of the songs.

[11] studied the song of a blackbird "airport population" located in the proximity of the two runways of the Madrid-Barajas airport and a "control population" living approximately 10 km north, both located inside the same river forest. They found that blackbirds living near the airport emphasized the loudest part of their songs by singing without a twitter part, and when they included a twitter part it was small, in an effort to reduce masking by airport noise. They advanced the singing timing and the chorus duration at dawn early in the season when it overlapped with aircraft activity. Later in the season, the singing timing of the blackbird chorus fell before the start of the aircraft activity, and there were no differences in singing timing between the airport and control populations.

[12] considered the songs of 37 bird species recorded by means of 36 stations arranged in three lines of 12 stations, disposed from the city of Saint-Nazaire to the nearby countryside. They found that the number of singing individuals, including Turdus merula, sharply increases from 5 a.m., reaching a maximum at 6:31 a.m. (10 minutes before sunrise), and then slowly decreases until noon. Large-eyed species tend to sing earlier than others, probably because of their enhanced capacity to see at low light intensity to detect potential predators or rivals. Another explanation proposed is that they sing earlier until they can see enough, earlier than others, for foraging. In general, birds sing earlier and for shorter periods of time in urbanized areas because of artificial light pollution and traffic noise. On the other hand, birds sing longer in the presence of a high number of birds of the same species [13].

3. Materials and Methods

The blackbird's song samples have been acquired by means of the Enregistreur Vocal application installed on a Galaxy S20 FE 5G portable phone. The song sample analysis has been performed by means of Audacity 3.7.8 (Compilation Date: Jun 11, 2026; 64 bits; Compiler: MSVC 19.44.35227.00; Central Libraries: wxWidgets: 3.1.3 (Audacity); PortAudio (Reading and Recording audio): v19; libsoxr (Sample rate conversion): Active).

To avoid confusion, the following terminology is adopted:

sequence = phrase + appendix;

phrase = one or more whistle parts;

silent interval.

The song came from the blackbird that landed on the balcony railing (**Figure 1**) directly behind me at a distance of about two meters. During some of the silent intervals, a similar sequence from a nearby blackbird was audible, which, unfortunately, the Enregistreur Vocal application did not manage to record.

4. Results

In total, ten song samples: Voix 004 - Voix 013 have been obtained, as shown in **Table 1**.

Table 1. Song samples.

Blackbird songs: Samples						
Sample	Date	UT	Lenght	Size (Kb)	Type	Sequences
Voix 004	2026/5/29	14:24	0:00:32	550	M4A	4
Voix 005	2026/5/29	14:25	0:00:31	530	M4A	4
Voix 006	2026/5/29	14:26	0:00:32	557	M4A	5
Voix 007	2026/5/29	14:27	0:00:39	668	M4A	4

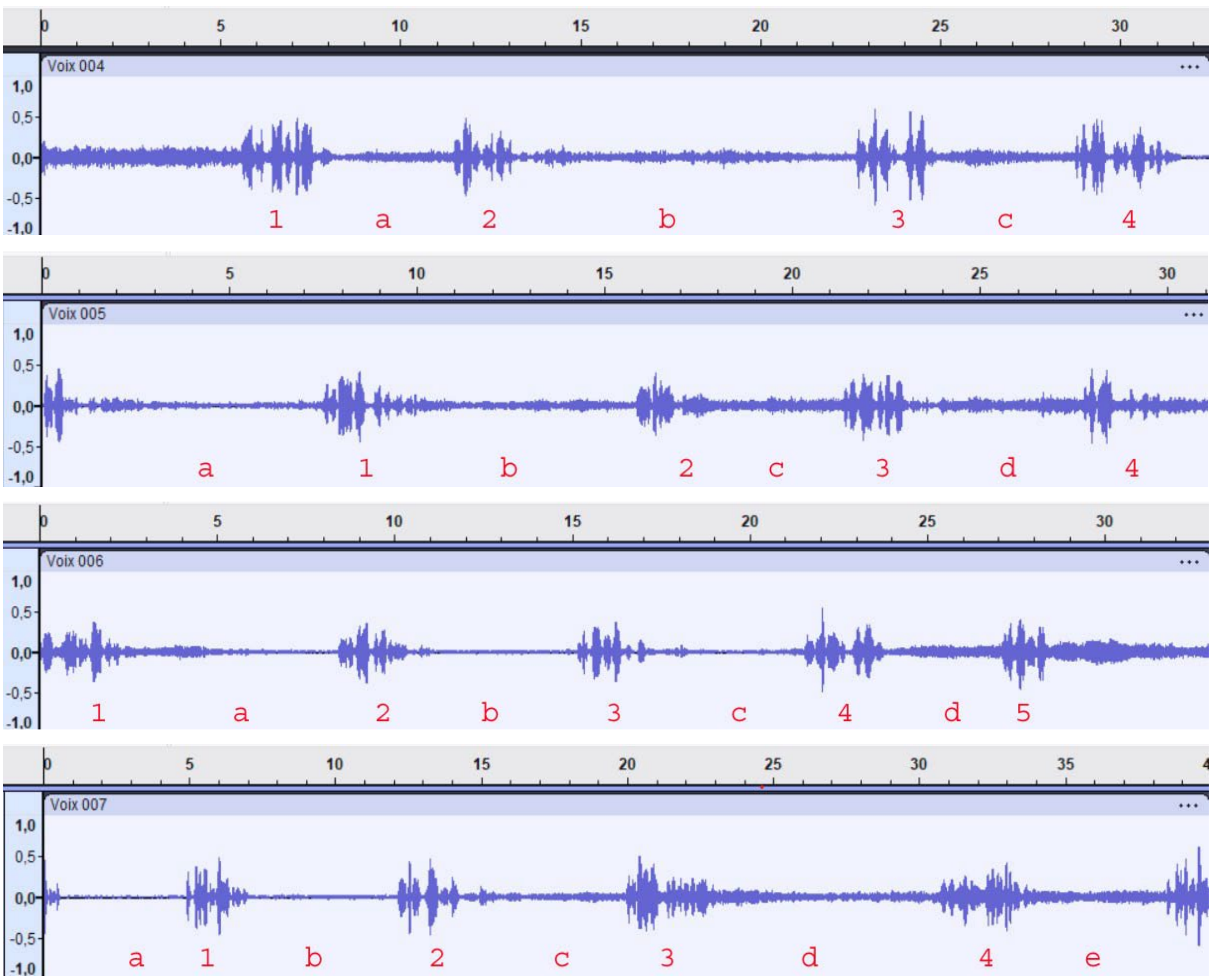
Continued

Voix 008	2026/5/29	14:28	0:00:33	561	M4A	4
Voix 009	2026/5/29	14:28	0:00:32	554	M4A	5
Voix 010	2026/5/29	14:29	0:00:37	629	M4A	5
Voix 011	2026/5/29	14:30	0:00:32	557	M4A	5
Voix 012	2026/5/29	14:31	0:00:33	562	M4A	4
Voix 013	2026/5/29	14:32	0:00:40	676	M4A	6
		Average:	00:00:34.1		Tot:	46

5. Discussion

5.1. Waveform Diagrams

The normalised waveform diagram of each sample (Figure 2, Figure 3) has been obtained by the instruction set: Audacity -> File -> insert the sample.



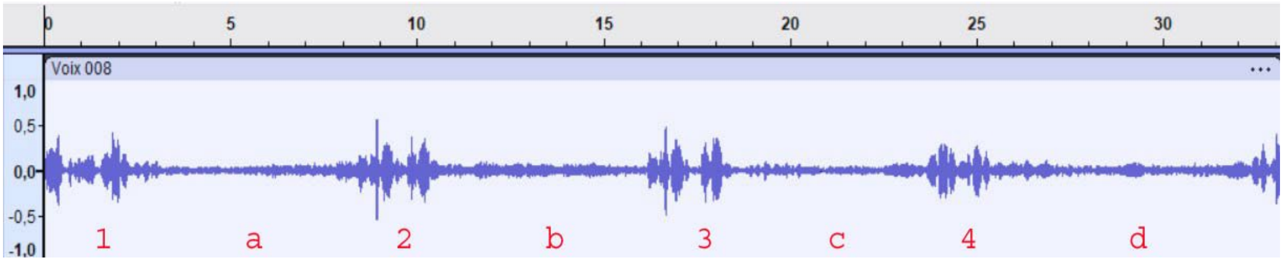


Figure 2. Normalized waveform diagrams Voix 004 - Voix 008.

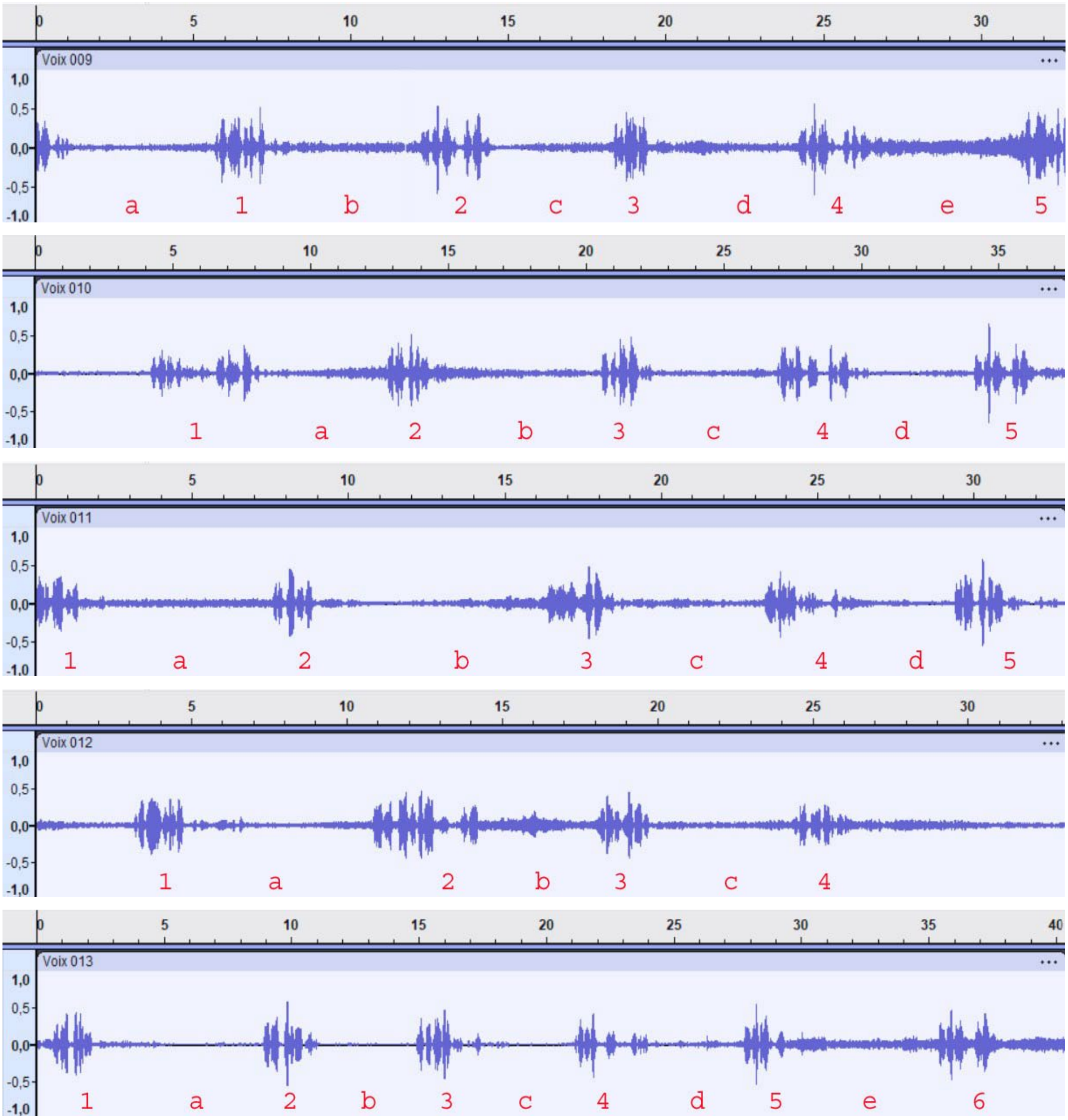


Figure 3. Normalized waveform diagrams Voix 009 - Voix 013.

In each normalized waveform diagram, sequences identified by numbers and silent intervals identified by letters can be distinguished. The total number of sequences is 46 (Table 1, last column), corresponding to 43 complete sequences and 3 incomplete sequences. In each sequence, several whistle parts can be identified, comprising an ascendant phase toward a high-pitched tone followed by a corresponding descendant phase toward a low-pitched tone. These tones are short and variable in amplitude. The amplitudes are between +/− 0.5 in the normalized waveform diagrams.

5.2. Enhanced Recording

The relatively quiet sound environment (wind, traffic, bells, people) suggested not applying the eliminating background noise process of Audacity to the files Voix 004 - Voix 013, in order to not reduce the sequence amplitudes.

5.3. Sequences and Silent Interval Lengths

The sequence and silent interval lengths of each sample (Table 2, Table 3) have been obtained by the instruction set: Audacity -> File -> insert the sample -> click on the end of the sequence or the silent interval -> read the time t2 -> click on the start of the sequence or the silent interval -> read the time t1 -> calculate t2 - t1.

The expected uncertainty on the measured lengths is about 0.45 s. The sequence lengths range between 1.396 s and 5.043 s (Table 2), with an average sequence length of 2.698 s; incomplete phrases have been excluded. The silent interval lengths range between 2.411 s and 8.744 s (Table 3), with an average silent interval length of 4.556 s. These lengths are in agreement with the results of [7] for the 80 breeding pairs of the Helgoland island (D). However, no sequence is similar to another one in either length or shape, and no silent interval is similar to another one in length.

Table 2. Blackbird sequence lengths, "~" means incomplete sequence.

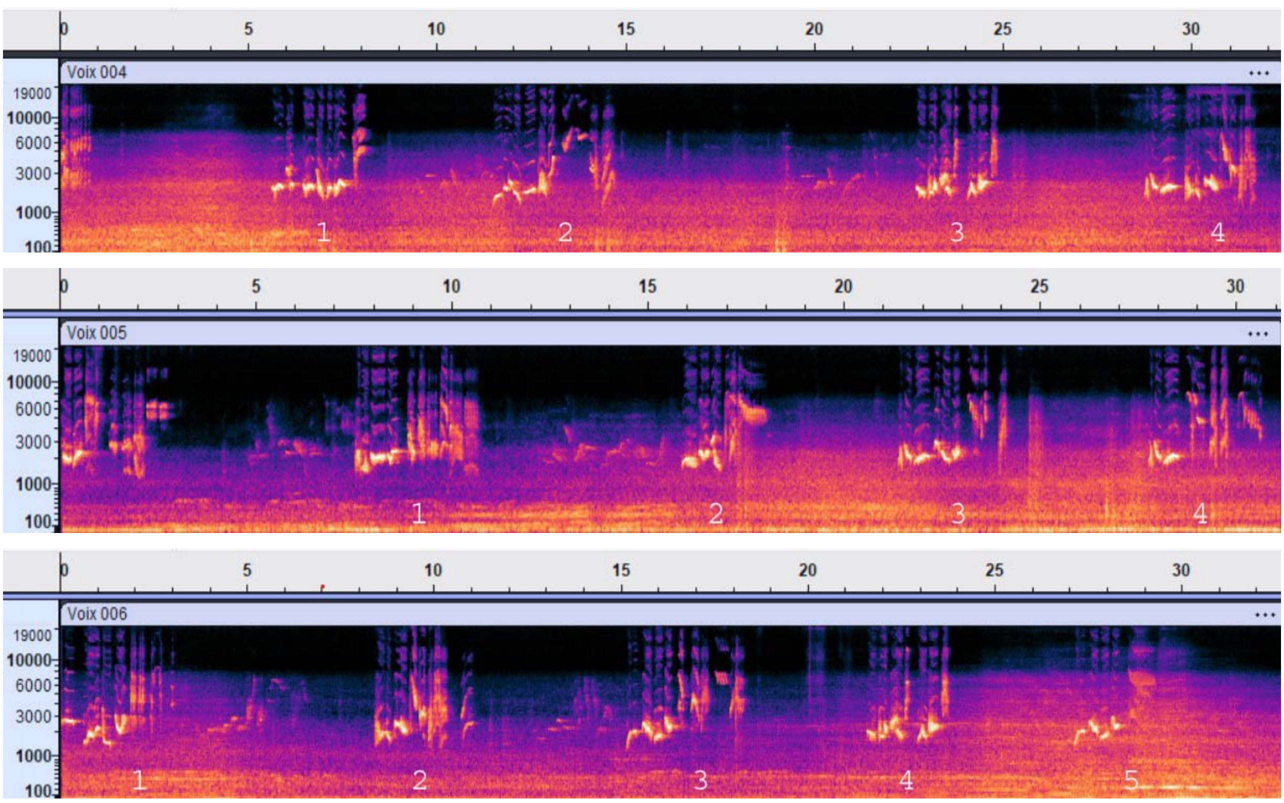
Sequence	Length	(s)				
Sample	1	2	3	4	5	6
Voix 004	2.444	3.271	2.341	2.995		
Voix 005	3.31	1.522	2.813	1.986		
Voix 006	~2.409	2.618	3.212	2.27	1.396	
Voix 007	2.284	3.129	4.059	3.383		
Voix 008	~3.200	2.813	2.285	2.883		
Voix 009	3.747	2.394	2.567	2.915	~1.423	
Voix 010	5.043	2.7	1.985	3.454	2.382	
Voix 011	2.339	1.216	2.479	2.688	2.514	
Voix 012	3.585	3.383	1.657	2.678		
Voix 013	1.585	2.313	2.527	3.04	3.213	2.616

Table 3. Blackbird silent interval lengths.

Silent interval	Lenght	(s)				
Sample	a	b	c	d	e	f
Voix 004	3.809	8.774	3.782			
Voix 005	4.766	4.733	4.22	3.839		
Voix 006	5.61	4.225	3.177	3.492		
Voix 007	3.689	4.99	4.313	5.92	4.44	
Voix 008	5.02	5.24	5.063	5.309		
Voix 009	6.939	3.157	3.886	2.845	3.955	
Voix 010	3.693	5.4	4.646	3.773		
Voix 011	5.272	7.368	4.26	3.387		
Voix 012	4.264	3.805	4.721			
Voix 013	6.681	3.983	2.411	3.726	4.197	

5.4. Spectrograms

The spectrogram or sonogram of each sample (Figure 4, Figure 5) has been obtained by the instruction set: Audacity -> File -> insert the sample -> select the track menu next to the name -> select Spectrogram.



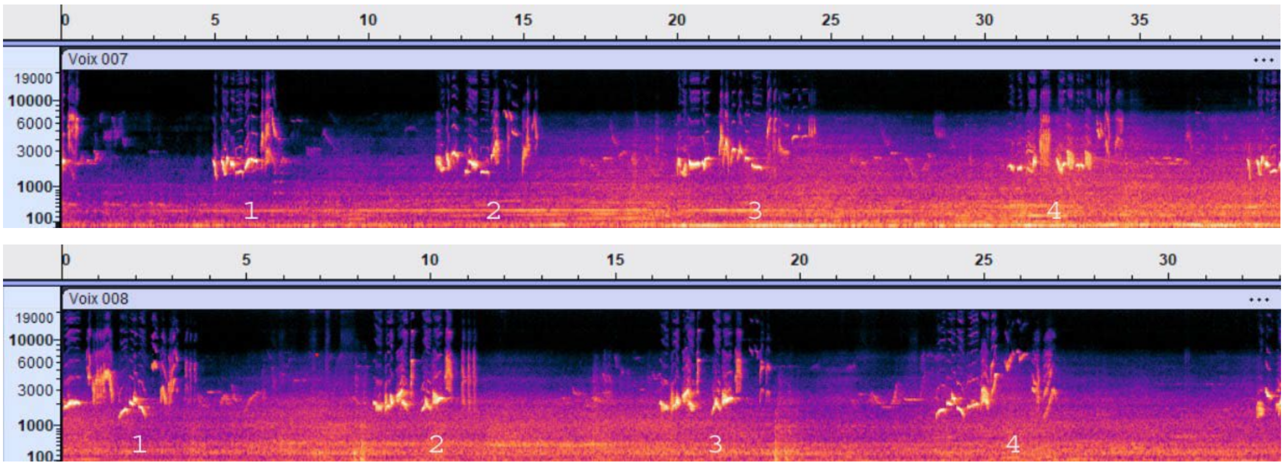


Figure 4. Spectrograms Voix 004 - Voix 008.

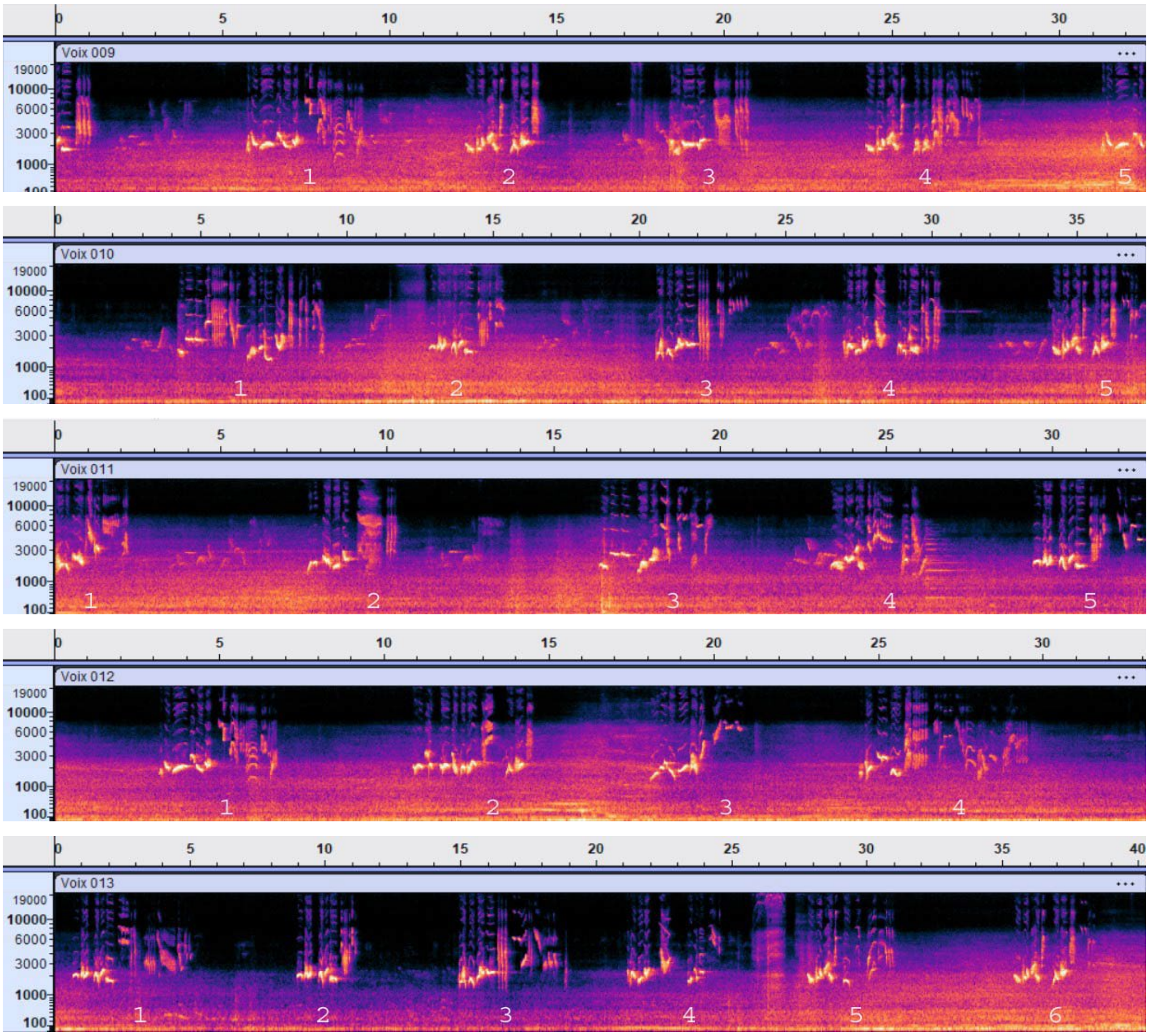


Figure 5. Spectrograms Voix 009 - Voix 013.

In each spectrogram, the lighter colour represents the higher emitted acoustic energy. Most of the emitted energy is concentrated between ~1.5 kHz and ~5 kHz. A smaller part is emitted between ~8 kHz and ~10 kHz. Above ~10 kHz, the emitted energy is negligible. The separation between phrases (lighter colour) and appendices (darker colour) now appears evident.

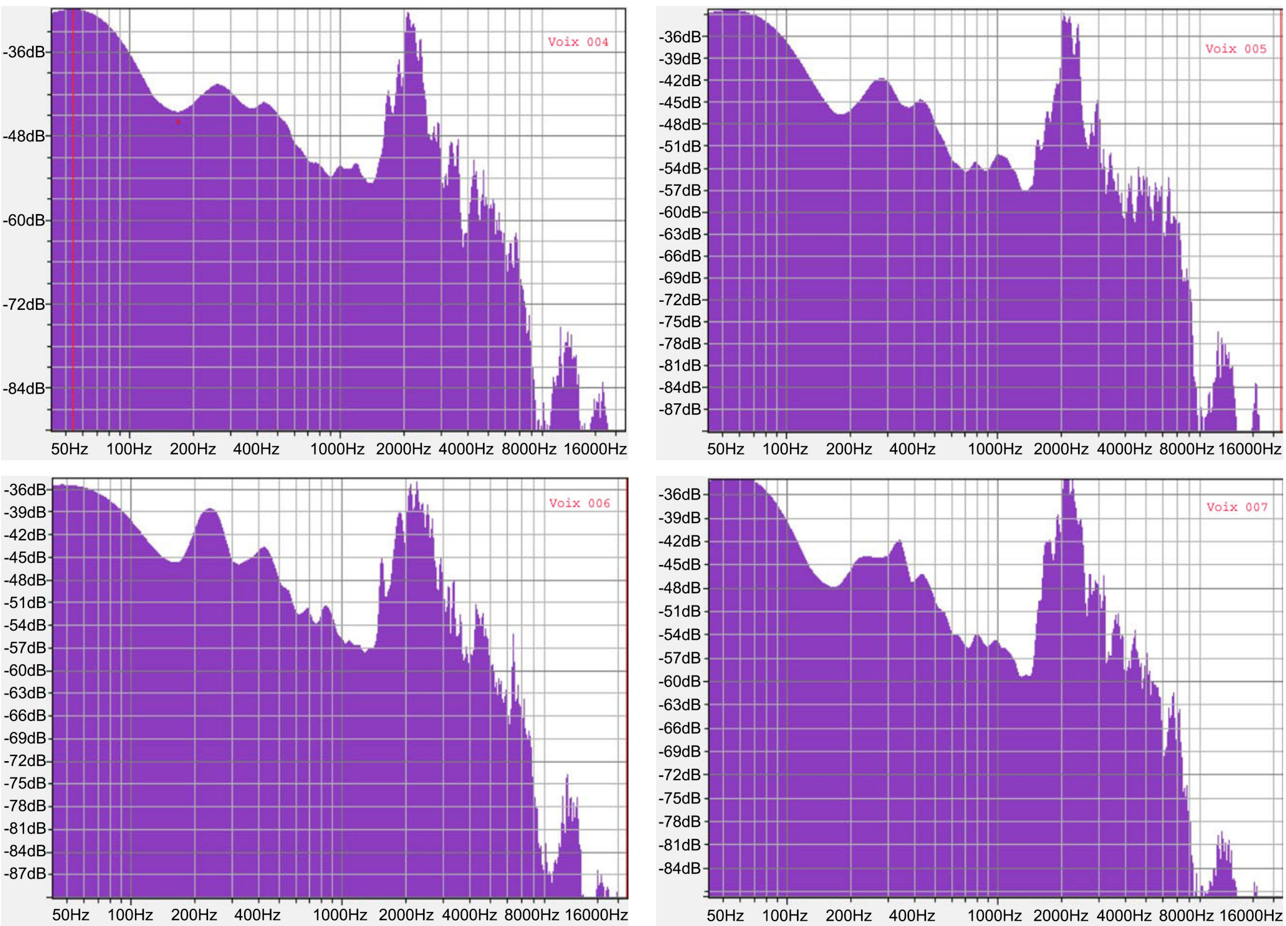
The horizontal or slightly inclined lighter portions correspond to the "flute" portion of Piana. (1999-2007). The vertical line portions represent very short sections containing, simultaneously, numerous frequencies.

Some portions display several parallel bands, indicating higher harmonics.

5.5. Fourier Analysis

The Fourier analysis diagram of each sample (**Figure 6**, **Figure 7**) has been obtained by the instruction set: Audacity -> File -> insert the sample -> Select All -> select Analyse -> select Trace Spectrum.

In the Fourier diagrams, it can be observed that a relevant part of the acoustic energy is emitted at frequencies < ~500 Hz, with a slow decrease between ~500 Hz and ~1.5 kHz, an energy peak at ~2.0 kHz, and a rapid decline above ~3 kHz. Harmonics of the energy peak at ~2.0 kHz are present in the rapid decline portion above ~3 kHz.



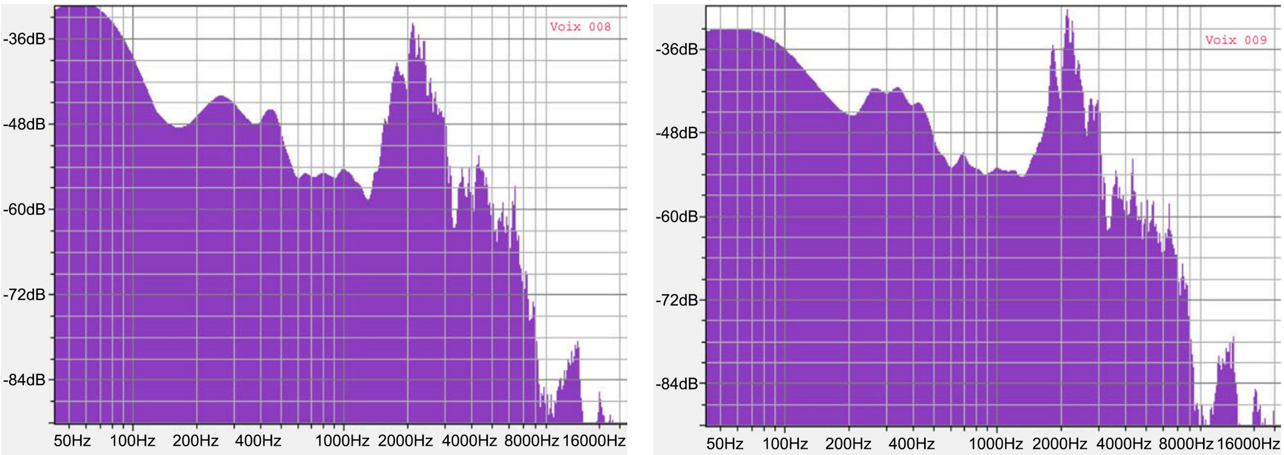


Figure 6. Fourier diagrams of the files Voix 004 - Voix 009.

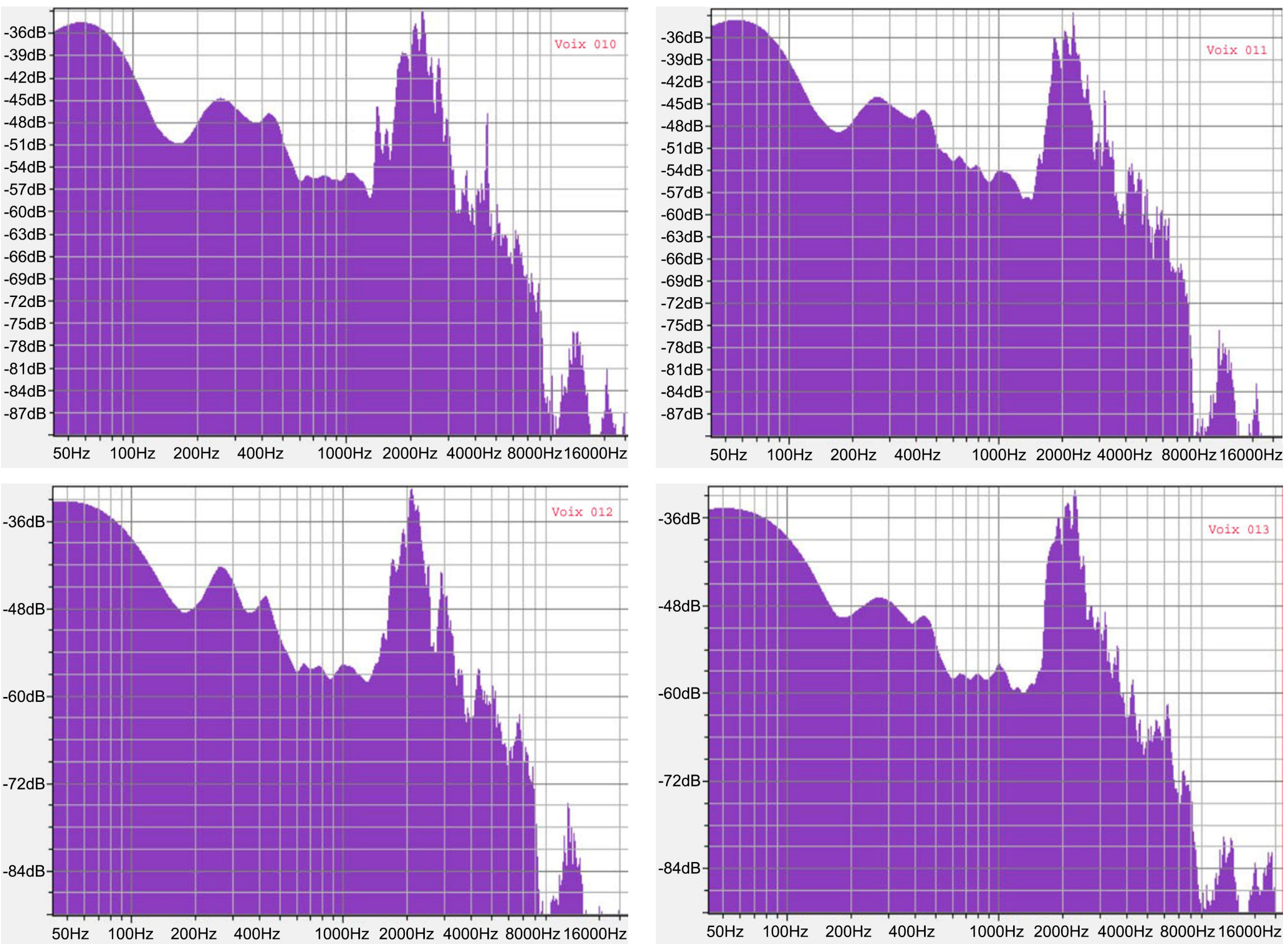


Figure 7. Fourier diagrams of the files Voix 010 - Voix 013.

The emitted acoustic energy presents a cut-off at ~8 kHz and ~9 kHz, although faint emissions are still present up to ~16 kHz.

It is reminded that the human ear has a theoretical sensitivity from ~20 Hz up to ~20 kHz, with maximum sensitivity between ~2 kHz and ~5 kHz and peak sensitivity around ~3 and ~4 kHz. For this reason, the blackbird song is clearly distinguishable and acoustically understandable.

6. Conclusions

The article is devoted to the implementation of a sensor package: Enregistreur Vocal application installed on a Galaxy S20 FE 5G portable phone and Audacity 3.7.8 for characterizing the blackbird song. From this point of view, it appears to be in line with the scope of the Journal of Sensor Technology.

Notwithstanding that the sequences in the blackbird song sound identical, the normalized waveform diagram of each sample has shown marked variations in their amplitude, length, and structure. The spectrogram of each sample permitted the separation of their phrases, identified by horizontal or slightly inclined lighter portions, and the appendices, very short vertical portions containing simultaneously numerous frequencies and higher harmonics identified by parallel bands. The Fourier analysis diagram of each sample permitted the identification of energy emission in different frequency fields and the energy cut-off frequencies. Audible, faint sequences in the songs of a nearby blackbird, as possible dialog replies to the sequences in the blackbird song, have not been recorded by Enregistreur Vocal. Whether an aesthetic activity is involved in the blackbird song remains an open question. The recorded raw song samples Voix 004 - Voix 013 are available on request.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Monde Animal (2026) Merle Noir, *Turdus merula*. https://www.monde-animal.fr/fiches-animaux/turdus-merula/

[2] Pallás, N., González-Andazola, I.A., Szabados, J., *et al.* (2024) Brood Sex Ratios in European Blackbirds (*Turdus merula*) across Urban and Forested Environments. *4th EOU Fledglings Meeting* 2024, Prague, 22-24 March 2024, 26. https://iris.unito.it/bitstream/2318/1985951/1/4th-EOU-Fledglings-Meeting-2024-Prague.pdf

[3] Les-Oiseaux.com, 2020-2025. Le Merle Noir (*Turdus merula*): L'Oiseau Chanteur de nos Jardins. https://www.les-oiseaux.com/Merle-noir.htm

[4] Hall-Craggs, J. (1962) The Development of Song in the Blackbird *Turdus merula*. *Ibis*, **104**, 277-300. https://doi.org/10.1111/j.1474-919x.1962.tb08659.x

[5] Piana, G. (1999-2007) Il canto del merlo, Archivio Giovanni Piana, Università degli Studi di Milano. Versione elettronica con esempi sonori incorporati. https://www.calameo.com/read/001341648ce956e1d2e49

[6] Kentish, B., Harvey, J., Roberts, L. and Ross, J. (2001) Multivariate Statistical Analysis of Songs of the Male Common Blackbird (*Turdus merula*): An Example from Western Victoria, Australia. *Emu—Austral Ornithology*, **101**, 335-340. https://doi.org/10.1071/mu00038

[7] Hesler, N., Mundry, R. and Dabelsteen, T. (2011) Does Song Repertoire Size in Com-

mon Blackbirds Play a Role in an Intra-Sexual Context? *Journal of Ornithology*, **152**, 591-601. https://doi.org/10.1007/s10336-010-0618-5

[8] Hesler, N., Mundry, R. and Dabelsteen, T. (2012) Are There Age-Related Differences in the Song Repertoire Size of Eurasian Blackbirds? *Acta Ethologica*, **15**, 203-210. https://doi.org/10.1007/s10211-012-0127-z

[9] Dominoni, D.M., Goymann, W., Helm, B. and Partecke, J. (2013) Urban-Like Night Illumination Reduces Melatonin Release in European Blackbirds (*Turdus merula*): Implications of City Life for Biological Time-Keeping of Songbirds. *Frontiers in Zoology*, **10**, Article No. 60. https://doi.org/10.1186/1742-9994-10-60

[10] Nordt, A. and Klenke, R. (2013) Sleepless in Town—Drivers of the Temporal Shift in Dawn Song in Urban European Blackbirds. *PLOS ONE*, **8**, e71476. https://doi.org/10.1371/journal.pone.0071476

[11] Sierro, J., Schloesing, E., Pavón, I. and Gil, D. (2017) European Blackbirds Exposed to Aircraft Noise Advance Their Chorus, Modify Their Song and Spend More Time Singing. *Frontiers in Ecology and Evolution*, **5**, Article No. 68. https://doi.org/10.3389/fevo.2017.00068

[12] Godet, L., Prampart, A., Lostanlen, V., *et al.* (2023) Temporal Structure of Avian Dawn Chorus along an Urbanization Gradient. https://hal.science/hal-04261154v1

[13] Dabelsteen, T. and Pedersen, S.B. (1988) Do Female Blackbirds, *Turdus merula*, Decode Song in the Same Way as Males? *Animal Behaviour*, **36**, 1858-1860. https://doi.org/10.1016/s0003-3472(88)80135-0