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Unravelling the mysteries of the Buff-breasted Button-quail *Turnix olivii*: a possible booming call revealed

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No alleged recorded calls of Buff-breasted Button-quail *Turnix olivii* have been directly linked to observations of an individual vocalising. Recorded calls have proven as elusive as a photograph of a live bird. The best descriptions of calls date back to the 1920s. Using spectrograms, we analysed the call structure of 'booming' calls recorded on automated recording units from the vicinity of Buff-breasted Button-quail sightings at Mt Mulligan, north-Queensland. These 'mystery calls' differed from spectrograms of other booming advertisement calls recorded elsewhere of other button-quail species with which the Buff-breasted Button-quail shares its habitat. The 'mystery calls' also differed from those of the Tawny Frogmouth *Podargus strigoides*, Papuan Frogmouth *P. papuensis*, and Common Bronze-wing Pigeon *Phaps chalcoptera*. The structure of the booming, advertisement calls recorded at Mt Mulligan was consistent with earlier descriptions by McLennan (1923) and White (1922) of booming calls of Buff-breasted Button-quail near Coen, north-Queensland. McLennan could imitate the call and successfully attract individuals of the species. We used playback of the 'mystery call' recorded on the automated recorders at Mt Mulligan to similarly entice a Buff-breasted Button-quail female, accompanied by a male, toward our playback location in February 2016, further suggesting that the 'mystery call' could be a recording of the focal species.

INTRODUCTION

A Mystery with History – The buff-breasted button-quail by Rogers (1995) paints a picture of a species of uncertain type locality, with few collected scientific specimens, and with poorly produced illustrations in several bird handbooks due to mistaken identity in some museum collections. During the 1930s, the Buff-breasted Button-quail *Turnix olivii* was lumped as a sub-species of the Chestnut-backed Button-quail *T. castanota*. Rogers (1995) argues that a lack of reported sightings of the species occurred between the 1920s and 1970s, possibly because of these issues. More recently, reported sightings have remained few, due in part to the cryptic and shy behaviour of Buff-breasted Button-quail, but also possibly because of the insufficient attention that bird observers, with greater interest in the more charismatic wet tropics species and environments, have paid to the dry habitat that it occupies (Rogers 1995; Squire 1990; L. Nielsen *pers. comm.*; AWC 2016, 2018; Mathieson and Smith 2017).

Additionally, the Buff-breasted Button-quail appears to be quite rare, although exactly how rare we do not really know. Its density and population size are likely to be low (Rogers 1995) and currently it is listed as endangered under Queensland and Commonwealth legislation. The species is, in reality, still poorly known (Mathieson and Smith 2009), with definitive photographs of a living bird and sound recordings of the species still lacking. Indeed, few people have heard the various calls it has been reported to make (McLennan 1923; Rogers 1995).

McLennan (1923) described five different calls of the Buff-breasted Button-quail, but his first encounter with its vocalisations was with the 'booming call,' which he imitated successfully. With respect to the booming calls, McLennan's diary entry (21 November 1921) reads: 'heard a deep booming call Oomm-oomm-oomm repeated rapidly for about 20 seconds, it begins very low & gradually gets louder & of a higher tone, last notes about 5 tones higher than first. Imitate call & bird answers a couple of times, in a few minutes I see it coming towards me through the short grass, get in a shot at 28 yds. & secure it.' He later adds that 'the *Turnix* dissection proved it to be a nesting female.' White's (1922) account of McLennan's observations from the same date adds that 'the first few notes were very low, and appeared to come from a great distance, the succeeding notes gradually higher in tone, louder, shorter, and were more rapidly uttered', and that 'the call takes about 30 seconds of time'.

McLennan (1923) mimicked the Buff-breasted Button-quail call (presumably the 'oom' call) on at least nine occasions, attracting single or multiple birds, or eliciting call responses. 'Oom' notes emitted by various *Turnix* species are considered advertising calls given by females, generally occur during the breeding season and can induce an aggressive response in other females (M. Mathieson, G. C. Smith *pers. obs.*; Rogers 1995). It is these 'booming' calls that Rogers (1995) suggests will prove most useful for bird watching purposes. Rogers (1995) cautioned that it will be necessary to distinguish the booming notes from the very similar notes of some other button-quail species, as well as from the Tawny Frogmouth *Podargus strigoides*, Papuan Frogmouth *P. papuensis* and Common Bronze-wing Pigeon *Phaps chalcoptera*, and that this should be achieved through an analysis of the call structures.

Rogers (1995) was frustrated by an inexplicable lack of calling at sites on the west of the Atherton Tablelands, but acknowledged that recordings of calls (which he added 'have never been tape-recorded') will be key to finding and identifying

birds. Recorded calls will indeed provide a much-needed tool for making further observations, possibly aiding photography of the species and in developing knowledge of its distribution and population size through using playback. They will also facilitate future monitoring opportunities by permitting identification of calls recorded on automated recording devices deployed in suitable habitat.

Here, we present sonographic analysis of the structure of 'mystery calls' recorded near the vicinity of a pair of Buff-breasted Button-quail observed on the ground at Mt Mulligan, north-Queensland (Mathieson and Smith 2017). Buff-breasted Button-quail were not actually observed making these calls, but we present evidence to suggest that these vocalisations were the booming calls of the species.

METHODS

All times-of-day given in this paper are in Australian Eastern Standard Time. The observations described here occurred at Mt Mulligan Station, to the west of Mareeba on the Atherton Tableland, where two Buff-breasted Button-quail were initially flushed on the 17 January 2016 at 10:00 hours (Mathieson and Smith 2017). Excellent views were obtained of the birds on the ground and subsequently as they flew in different directions. Soft 'oom' notes were later heard coming from the area where one bird was thought to have landed.

A Bioacoustic Recorder (BAR – Frontier Labs™) was deployed near to where we flushed our first pair of birds and set to automatically record continuously for three hours prior to sunset and six hours after sunrise. We left the site at approximately 12:30 hours and visited intermittently over the next two days, sighting birds on a further two occasions during this time. The BAR was set to record from 15:51 hours on 17 January to 11:04 hours on 19 January, providing us with 24 hours of ambient sound to analyse.

To identify calls that could be considered as possible button-quail calls, we listened to the recordings through headphones and displayed spectrograms of the ambient noises recorded using Raven Lite™. Button-quail and frogmouth species call within a frequency range less than 500 Hz (BOCA 2001; *Xeno Canto* 2018), so we concentrated our effort on the lower frequencies, manipulating parameters of brightness, contrast and the Fast Fourier Transform (FFT) window size in Raven Lite™, so that calls within this range could be clearly distinguished.

Each of our 'mystery calls' was made up of a series of 'oom' syllables, which equated to the 'notes' or individual 'ooms' of McLennan (1923) and White (1922), whose descriptions originated from Coen, some 375kms to the north of the Mt Mulligan site. Spectrograms for each call sequence that we found on our recordings were measured as follows: mid-frequency of start 'oom'; mid-frequency of end 'oom'; the number of 'ooms' per second; duration of a mid-range 'oom'; 'oom' shape; number of 'ooms' to a full call and duration of the entire call from the beginning of the first identifiable 'oom' to the end of the last identifiable 'oom'. Mid-frequency measurements of 'ooms' were made at the point of maximum amplitude, using the waveform graph in Raven Lite™ where possible or the colour intensity output available in the spectrogram. Measurements of these parameters from the 'mystery' recordings were compared with measures for Painted Button-quail *T. varia*, Red-backed Button-quail *T. maculosa*, Little Button-quail *T. velox*, Tawny Frogmouth, Papuan Frogmouth and Common Bronze-wing obtained from recordings available in BOCA (2001) and *Xeno Canto* (2018). No calls were available from these sources for Red-chested Button-quail *T. pyrrhothorax*; the call previously thought to be that of a Red-chested Button-quail in BOCA (2001) was later reallocated to Red-backed Button-quail (D. Stewart *in litt.*).

Booming calls isolated as possible Buff-breasted Button-quail calls were snipped from the longer recordings and uploaded to a device for later playback in the field. Playback using the snipped call, tentatively identified as a Buff-breasted Button-quail vocalisation, was conducted during a second field trip (25 February to 2 March 2016) to the Mt Mulligan field site. The call was played through a single powered speaker at low volume several times on one occasion at this site.

RESULTS

Call analyses

Thirty-two vocal sequences were identified for further consideration as Buff-breasted Button-quail booming calls from the 24 hours of recording made in January 2016. However, many of the call sequences were not analysed for several reasons; some birds were too far from the recording unit and their calls were therefore indistinct, some calls were truncated at the beginning or end of the call sequence, and some calls seemed out of the plausible frequency range of the species. Measurements were consequently made of 25 call sequences. A summary of measurements obtained from the Mt Mulligan calls and the reference calls of other species (i.e. other button-quail, Tawny and Papuan Frogmouths and Common Bronze-wings) is provided in Table 1.

Two types of booming call were identified for the Buff-breasted Button-quail (Figure 1). One call began at low frequency in the 200-230 Hz range and then rose to a frequency around 270 Hz. The other call began in the frequency range below 210 Hz and either stayed at a low frequency or sometimes drifted lower to frequencies less than 200 Hz and down to c. 190 Hz. Combined measurements for these two call types are summarised in Table 1. All calls began with less distinct and less powerful 'ooms', but became more powerful as the train of 'ooms' proceeded. We could not detect that each 'oom' became shorter as each call sequence progressed.

Painted Button-quail calls from BOCA (2001) and *Xeno Canto* (2018) overlapped the frequency ranges of those of Buff-breasted Button-quail, but they tended to start and end at a higher frequency (Table 1). 'Ooms' were also somewhat different in shape and slightly longer in duration, but there was still possibility for confusion. Like the Buff-breasted Button-quail, the Painted Button-quail also make calls at a constant frequency, but this occurs at higher frequencies than the non-rising calls of Buff-breasted Button-quail.

In unambiguous contrast to Buff-breasted Button-quail, the rising calls of Red-backed Button-quail and Little Button-quail all began at higher frequency ranges and rose to a higher pitch (Table 1). Additionally, Little Button-quail called at higher frequencies and at a much slower rate than all the other button-quail. Furthermore, they can produce a double note to each 'oom' element of their call, which is not apparent among the other button-quail.

Table 1

Measurements (range, mean, standard deviation (s.d.) and sample size (n)) of calls of button-quail species, Tawny and Papuan Frogmouths and Common Bronze-wing Pigeon. Only complete calls were used where possible to provide figures for the number of 'ooms' to a full call, and duration of entire call comprised a train of 'ooms'. Complete calls were distinguished by noting significant time gaps between calls. Sources include: [1] Bird Observers Club of Australia (2001) published recording, [2] *Xeno Canto* (2018), and [3] www.graemechapman.com.au

Call ID	Main/mid-frequency (Hz) of start 'oom': range, mean ± s.d. (n)	Main/mid-frequency (Hz) of end 'oom': range, mean ± s.d. (n)	'Ooms' per second: range, mean ± s.d. (n)	Duration of mid-range 'oom' (secs): range, mean ± s.d. (n)	Description of 'ooms'	No. of 'ooms' to a full call: range, mean ± s.d. (n)	Duration of call of 'ooms' (secs): range, mean ± s.d. (n)	Source of call
Proposed Buff-breasted Button-quail from Mt Mulligan	195-230, 215 ± 9 (25)	192-280, 228 ± 36 (25)	1-1.1, 1.0±0.03 (25)	0.4-0.7, 0.6±0.1 (25)	Each 'oom' initially falls then rises in frequency. Individual 'ooms' shaped like upward horseshoe	16-34, 24±4 (25)	16-35, 23±4 (25)	G.C. Smith, M.T. Mathieson
Painted Button-quail	212-233, 222±9 (6)	260-293, 282±12 (7)	1.0-1.2, 1.1±0.1 (7)	0.5-1.0, 0.6±0.2 (7)	Slight upward inflection in each 'oom'	23-33, 28±4 (6)	22-28, 24±2 (6)	BOCA[1]; S. Connop[2], M. Anderson[2], G. McLachlan[2]; G. Chapman[3]
Red-backed Button-quail	299-318, 308±13 (2)	352-388, 370±25 (2)	0.9-0.95, 0.9±0.04 (2)	0.8-1.0, 0.9±0.1 (2)	Each 'oom' rises in frequency	21-25, 23±3 (2)	22-26, 24±2 (2)	BOCA[1]
Little Button-quail	390-440, 407±29 (3)	430-458, 440±16 (3)	0.3-0.4, 0.3±0.1 (3)	1-1.2, 1.1±0.1 (3)	Individual 'oom' rises in frequency, or some 'ooms' comprise a double note given in either high to low or low to high sequence.	9-10, 9±1 (3)	20-36, 27±8 (3)	BOCA[1]; M. Anderson[2]
Tawny Frogmouth	205-293, 237±33 (13)	237-296, 257±23 (13)	1.7-2.4, 2.1±0.3 (13)	0.3-0.6, 0.4±0.1 (13)	Each 'oom' rises in frequency. Across the call train, 'ooms' are rapid at first but then become more constant in timing.	21-48, 35±9 (13)	11-24, 17±4 (13)	BOCA[1]; M. Anderson[2], J. Hegge[2], N. Jackett[2]
Papuan Frogmouth	183-322, 264±40 (20)	192-370, 294±55 (20)	0.8-1.2, 1.0±0.1 (20)	0.5-0.9, 0.6±0.1 (20)	Across the call train, 'ooms' of one sex rise to a peak then fall. Sex differences apparent in calling frequency.	5-16, 11±3 (20)	5-16, 11±3 (20)	BOCA[1]; H. Mateve[2], G. Wagner[2], J.V. Moore[2], F. Lambert[2], J. Dumbacher[2]
Common Bronze-wing	239-301, 273±20 (7)	242-303, 275±20 (7)	0.3-0.5, 0.4±0.1 (7)	0.7-1.1, 0.8±0.2 (7)	Downward inflection in frequency to each 'oom'.	8-29, 18±8 (6)	20-68, 43±20 (6)	BOCA[1]; M. Harper[2], M. Anderson[2], N. Jackett[2], G. McLachlan[2], S. Bushell[2]

The booming calls of the Tawny Frogmouth, whilst in the same frequency range as those of Buff-breasted Button-quail, were twice the speed of those of Buff-breasted Button-quail and were therefore distinctive on that basis alone (Table 1). Papuan Frogmouths began and finished their calls at frequencies that spanned those of Buff-breasted Button-quail. Unlike the Tawny Frogmouth, the Papuan Frogmouth called at similar speed and 'oom' duration to Buff-breasted Button-quail; however, its calls always contained fewer 'ooms' and were shorter. The Papuan Frogmouth calls analysed from *Xeno Canto* (2018) appeared complete, with periods of silence between them, but it was unclear whether the BOCA recordings were complete. The BOCA recordings of calls of Papuan Frogmouths in Australia were also lower in frequency than all those recorded in New Guinea. Other low, soft calls of the Papuan Frogmouth were also recorded in New Guinea and were given in response to the higher call, presumably of the mate (Marchant and Higgins 1993). The low frequency calls recorded in Australia and New Guinea changed little in frequency from the beginning 'oom' to the end 'oom' of the call, whilst the higher frequency calls increased in pitch.

In comparison to the Common Bronze-wing calls, the 'mystery' calls obtained from the Mt Mulligan area were much faster, began at a lower frequency and tended to rise in frequency, whereas the frequency of 'ooms' in the Common Bronze-wing call did not rise or fall throughout the call.

Call Playback

On the 25 February 2016, we returned to Mt Mulligan Station where Buff-breasted Button-quail had been observed in January 2016. Between 08:15 and 11:30 hours, we checked a

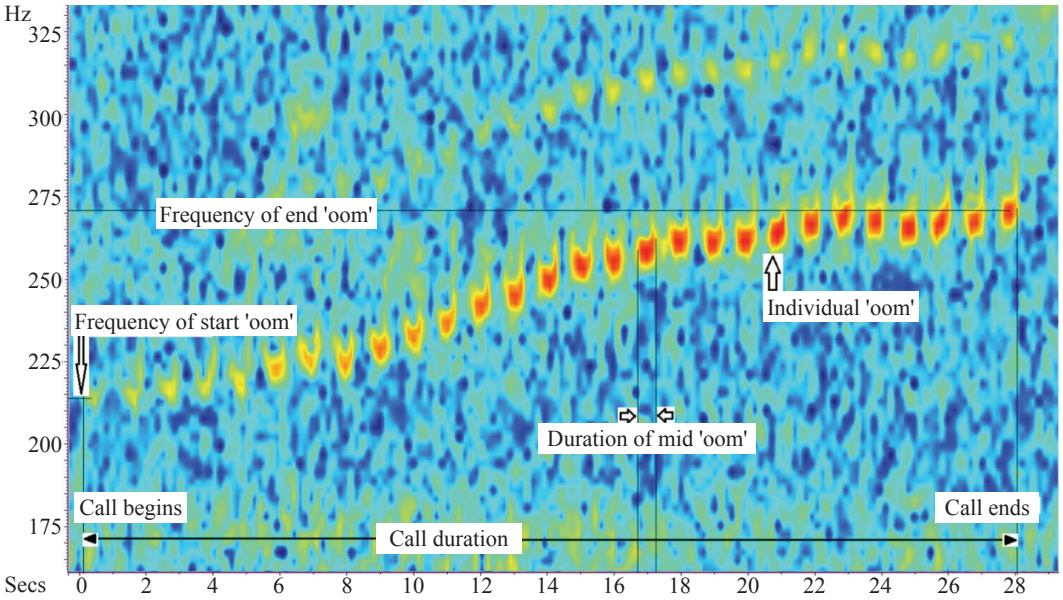

Figure 1. *Spectrogram of a 'mystery' booming call from Mt Mulligan, showing the characteristic rising call described by McLennan (1923) and White (1922). In addition to the fundamental note of the call, harmonics are also displayed. Vertical axis is in Hz and horizontal axis in seconds.*

large part of the 12ha area previously visited. Throughout our January fieldtrip we had encountered no other button-quail species during our visits to this site. However, on the morning of the 25 February 2016 we flushed a Red-chested Button-quail. Whilst we did not see Painted Button-quail that morning, this species was encountered the following day.

Despite the possibility that now existed for confusion, on the morning of the 25 February we heard the deep booming of a button-quail that was compatible with those we had heard on the January 2016 recordings and which we had available for an opportunity to perform playback. We promptly played the call and presently a female Buff-breasted Button-quail appeared. At approximately 8m from the playback speaker the bird stopped and, having evidently seen one or both of us, turned around and disappeared through the grass. After a brief period of continued playback and waiting, no bird returned and we were sufficiently confident that the bird had been 'spooked' by our presence. We packed up and walked in the direction that the female had retreated. After a short traverse of some 20m we again encountered the female (and an accompanying male) Buff-breasted Button-quail, getting good identifying views before they flew off a considerable distance.

DISCUSSION

Although we have not obtained calls directly from observed vocalising birds, we are confident that the 'mystery calls' recorded on the automated recording devices deployed at Mt Mulligan are those of Buff-breasted Button-quail. The evidence is three-fold. Firstly, the calls are mostly different to calls issued by similar booming species that also inhabit the range of the Buff-breasted Button-quail. Secondly, these recordings fit the descriptions given by McLennan (1923) and White (1922). Thirdly, the behavioural response of Buff-breasted Button-quail to playback of the call was interpreted as a reaction to a perceived conspecific.

The calls recorded at Mt Mulligan appear to differ sufficiently from the reference calls that we have obtained from various sources for co-occurring species, with which Rogers (1995) expressed concern about misidentification. In summary, Painted Button-quail (the button-quail species with the most similar call) tended to call at higher frequencies than those of the calls from Mt Mulligan, Tawny Frogmouths called at a faster rate, whilst Papuan Frogmouths called for shorter times with fewer 'ooms' in each call. In addition, Papuan Frogmouth calls sound different to the human ear, which is also reflected in the spectrograms possessing a slight upward inflection to each 'oom' of the call. The Common Bronze-wing calls at a slower rate, at a higher frequency and its call neither ascends nor descends in frequency across its duration.

McLennan (1923) reported the booming call as a deep 'oomm-oomm-oomm,' repeated rapidly for about 20 seconds (or 30 seconds, White 1922). The calls recorded from Mt Mulligan ranged in duration from 21.6 to 27.9 seconds, giving 23 to 28 'booms' per entire call duration, which appears to match the McLennan (1923) observations. This author and White (1922) made two further remarks: firstly, the 'oom' call began with very low notes, appearing to come from a great distance, and they gradually got louder and were of a higher tone by the end of the call, and secondly the last notes were about five tones higher than the first one. Observations at Mt Mulligan accord with the first point, in that the lowest frequencies of the recorded ascending calls (Figure 1, Table 1) were typically quieter and 'less forced' than the higher frequencies, giving an overall impression that they could have been uttered at a distance. Additionally, the calls got louder, as evidenced in the increasing intensity of colour in each 'oom' syllable, and of a higher pitch (or frequency) (Fig. 1). Addressing the second observation is more complicated and our findings are equivocal with those of McLennan and White. Whilst the pitch of each 'oom' cannot be converted directly to a tone (as a tone is an overall quality of pitch), the low notes recorded in our call sequences (*c.* 209 Hz

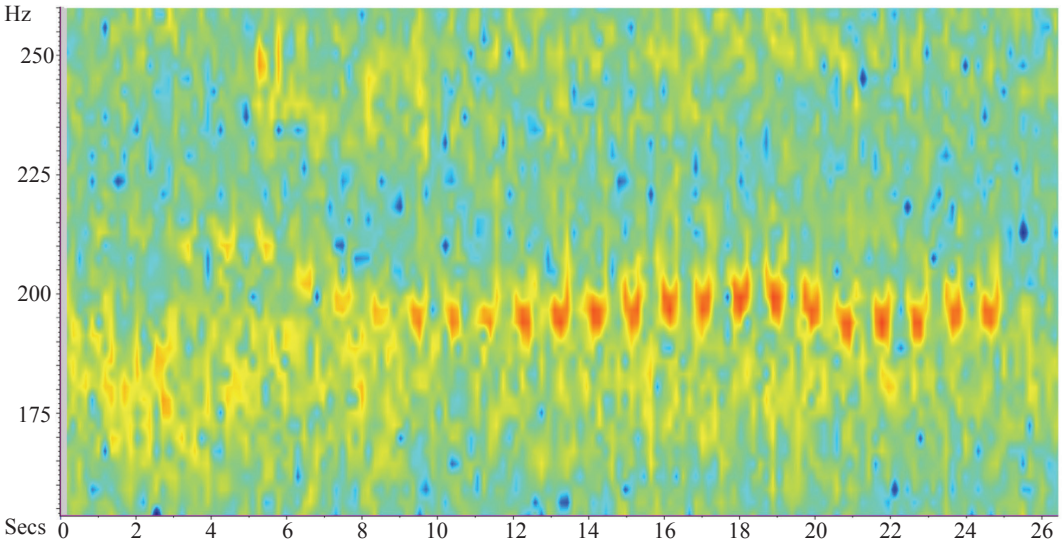

Figure 2. *Spectrogram of a 'mystery' booming call from Mt Mulligan, showing a low, non-rising call. Vertical axis is in Hz and horizontal axis is in seconds.*

of the rising calls in Figure 1 and 192 Hz in the low meandering calls in Figure 2) corresponded to somewhere around a G note, whilst the high notes (*c*. 270 Hz) corresponded to a C or C# note. Thus, the rise in pitch of the Mt Mulligan calls could be interpreted as a rise of some five to six semi-tones from lowest to highest, not the 'five tones higher' as recorded by McLennan (1923) and White (1922), but more like five to six notes higher, which is possibly what McLennan was referring to, although this remains speculative.

The final piece of evidence to support our contention that the 'mystery calls' from Mt Mulligan are those of Buff-breasted Button-quail is that a female of this species (with an accompanying male) was attracted to playback of the call that we believe to be that of her own species. Rogers (1995) believed that the 'oom' calls given by button-quail are 'interesting in that they often provoke an aggressive response from females'. McLennan (1923) attracted several individuals by imitating booming calls, and it is likely that still better results could be achieved with modern play-back equipment. We suggest that the attraction of the female Buff-breasted Button-quail to a digitally recorded call of the same species at Mt Mulligan constituted the aggressive response that Rogers (1995) alluded to and that McLennan (1923) observed.

Whilst further research is needed to be wholly assured of the identity of the calls that we obtained, we are confident that obtaining calls of this species (such as the call that we have recorded) will greatly assist future searches for, and monitoring of, the species by allowing the use of playback and call recognition. If the distinctive low tones that we have seen on spectrograms are emitted by the Buff-breasted Button-quail rather than any other button-quail species, then a significant call 'signature' has possibly been found. This signature will be useful in developing an automatic call recognition algorithm for identifying Buff-breasted Button-quail from remote and automatic recorders deployed in the field. Recognition software and automatic recorders are one of the ways of the future for studying cryptic, shy and rare species, such as the Buff-breasted Button-quail.

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