Species detection framework using automated recording units: a case study of the Critically Endangered Jerdon's courser

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SUPPLEMENTARY MATERIAL 1 Attenuation experiment to determine grid size for recorder deployment.

To determine grid size for deploying recorders we carried out a call playback attenuation experiment following (Yip *et al.,* 2017) at Sri Lankamaleswara Wildlife Sanctuary, the original habitat of the Jerdon's courser and at comparable habitat near Yerpedu (13° 41' 37.32" N, 79° 35' 38.4" E) which was also suggested as a potential Jerdon's courser site by Bhushan (1994).

To determine the amplitude of the call without any previous reference, we tested the volume for playback using a FoxPro Predator speaker (FOXPRO Inc. at different volumes and distances, from an observer (PJ) who has heard Jerdon's courser vocalisations on the field, following Darras *et al.* (2018). The FoxPro speaker is thought to reproduce animal sounds very accurately (MacLaren *et al.* 2018) and the volume of 20 points on this device (arbitrary volume scale for a specific recording) was auditorily verified as the approximate amplitude of the call . When measured with a Sound Level Meter (Mextech SL36, measurement range LP :30~130dB (A-weighted)) the average sound pressure level (re 20 µPa) of the Jerdon's courser call at a distance of 25m from the observer (PJ) was recorded as 71 dBA and the ambient sound was recorded as 51 dBA.

For the attenuation experiment, we used four types of commercial recorders - SongMeter4 (Wildlife Acoustics), Swift (Cornell Center for Conservation Bioacoustics), Rugged Swift (modified Swift in a Pelican casing), and AudioMoth (Open Acoustics) in a waterproof casing (AudioMoth for testing). All recorders had one functional omnidirectional microphone and were deployed simultaneously ~1.5m above the ground. The Jerdon's courser call was played using the FoxPro Predator speaker placed 1m above the ground (set to 20 points volume), oriented towards the recorders, at distances of 100m, 200m, 300m, 400m, 500m, 600m and 700m from the recorders. All recordings were then examined in the spectrogram format using Raven Pro (Supplementary Figure 1).
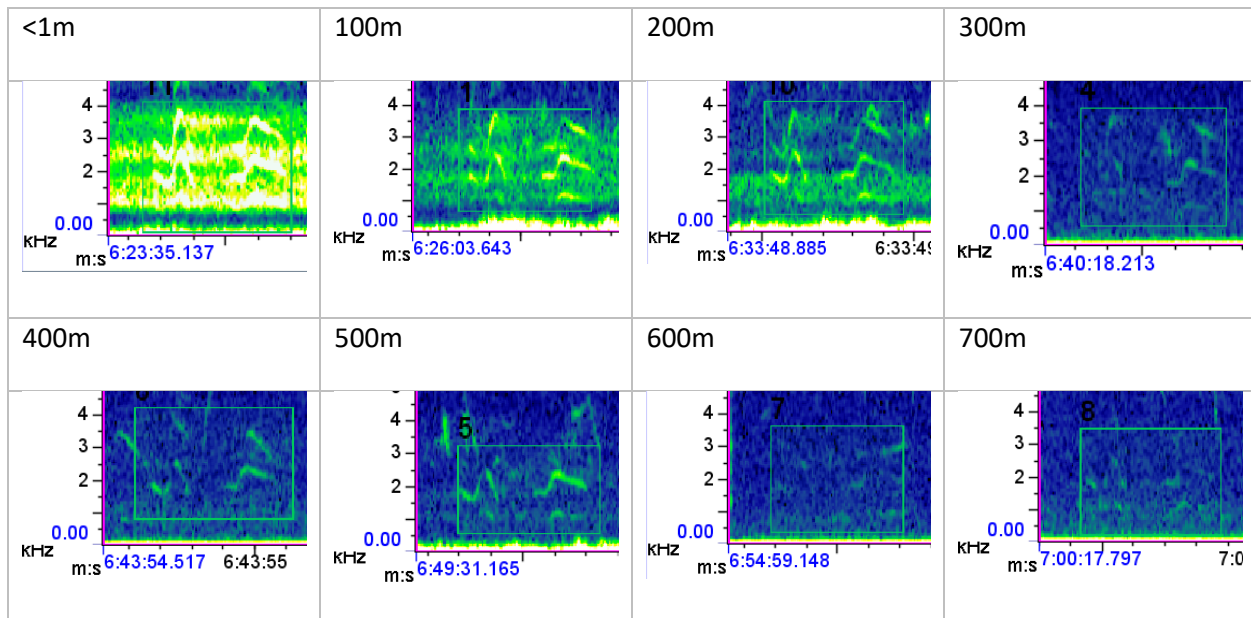
SUPPLEMENTARY FIG. 1 The panels represent the spectrogram view of the Jerdon's courser call (denoted within in green rectangles) recorded at various distances (<1 m, 100 m, 200 m, 300 m, 400 m, 500 m, 600 m, 700 m) on the Rugged Swift recorder during the attenuation experiment.

SUPPLEMENTARY TABLE 1 Comparative details of the four recorder types used to detect Jerdon's courser.

Function	AudioMoth	SongMeter4	Swift	Rugged Swift
Configuration settings				
Cost	53 USD	849 USD	250 USD	300 USD
Sampling rate (kHz)	48	44.1	48	48
Gain	30.6dB (medium)	16dB (default)	33dB (default)	33dB (default)
File size	1 hour	1 hour	1 hour	1 hour
Battery (number x type)	3 x AA cell	4 x D-cell	3 x D-cell	12 x D-cell
Max SD Card capacity	128GB	256GB	256GB	256GB
Data collection				
Max detection distance for Jerdon's courser call	500m	700m[#]	700m[#]	700m
Average total data collected (Gigabytes /cycle	65.7 ± 2.19	121.63 ± 4.47	144.2 ± 1.3	238*
Average days run	12.4 ± 0.55	31.25 ± 0.70	34.6 ± 0.54	57*
Average hours run	182	406.25 ± 8.59	449.8 ± 6.63	741*

[#] Two recorders (SongMeter4 and Swift) did not record calls at 600 m and was faintly observed in our attenuation experiment to determine grid size (Supplementary Fig. 1) in the spectrogram of the Rugged recorder, this could be perhaps due to wind during the 600 m range of playback.

*The Rugged Swift card capacity of 256 GB was full by day 57, although the battery life was not exhausted. We would expect it to run for c. 80 days with a 512 GB memory card.

A team of researchers from IISER Tirupati and NCF deployed Automated Recording Units at SriLankamalleswara Wildlife Sanctuary between Oct 2019 and March 2020 to try and detect the Jerdon's courser (JC) through its call. We observed a few unusual vocalizations that fall withinthe Jerdon's courser calling band that we were unable to identify.

We would request you to please assess the following four calls below and provide us feedback on whether the call is more or less likely to belong to the Jerdon's courser. If not, then to pleaseidentify the species it belongs to.

For the unknown calls, a selection box has been drawn around the target call and only this is audible in the clip provided here. A buffer region around some target calls has been included to provide the context of the call. In the provided dynamic spectrograms, the green region denotesa strong acoustic signal whereas the blue region denotes a weak signal.
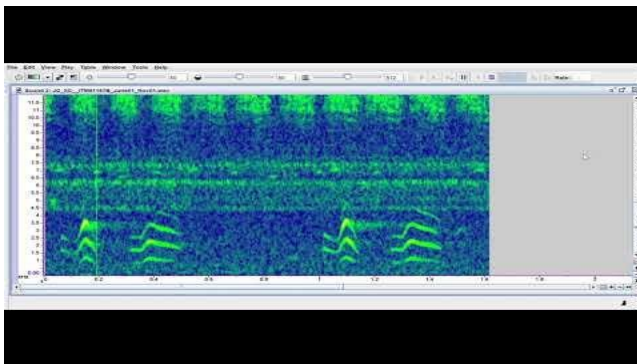
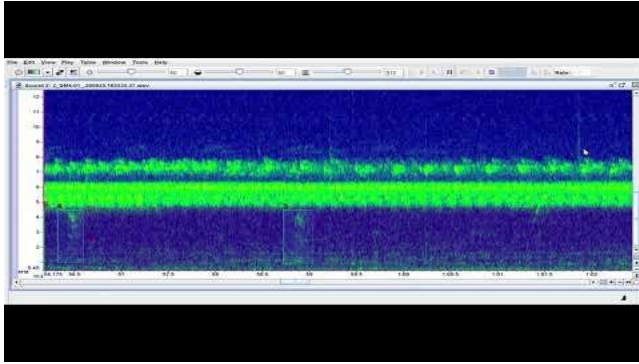Here is the original Jerdon's courser recording by P Jeganathan
https://www.xeno-canto.org/294415 (also provided below)

* Required

1.   Email address *

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Call of the Jerdon's courser for reference

http://youtube.com/watch?v=nduj9mbyTYs

Call 1 - 02/12/2019 - 23:43hrs

http://youtube.com/watch?v=epfrZyhTqdI

2. How likely do you think call 1 belongs to JC

Mark only one oval.

	1	2	3	4	5	
Highly unlikely	◯	◯	◯	◯	◯	Very likely

3. If not JC, call 1 belongs to which species?

Call 2 - 02/12/2019 - 23:59hrs

http://youtube.com/watch?v=ylw8GnmTKf4
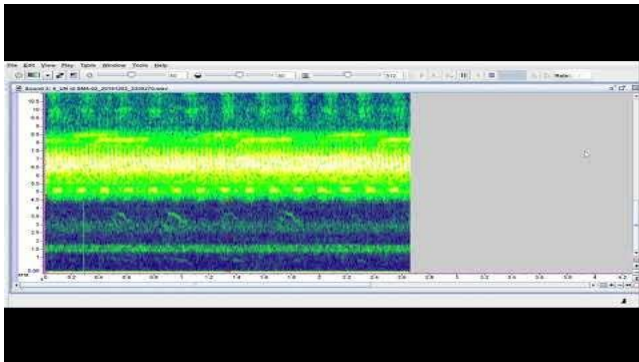
4. How likely do you think call 2 belongs to JC

Mark only one oval.

	1	2	3	4	5	
Highly unlikely	◯	◯	◯	◯	◯	Very likely

5. If not JC, call 2 belongs to which species?

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Call 3 - 17/11/2019 - 02:00hrs

http://youtube.com/watch?v=kMVOO7BIlms
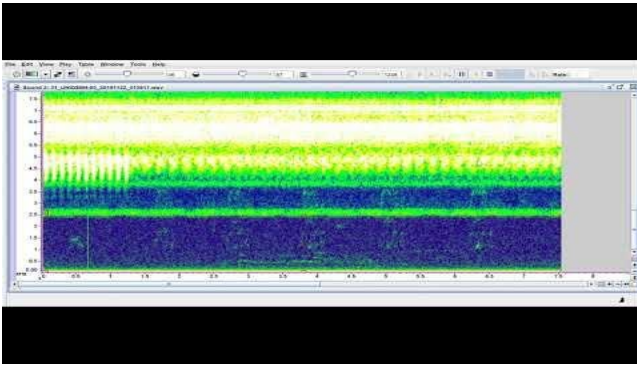
6. How likely do you think call 3 belongs to JC

Mark only one oval.

	1	2	3	4	5	
Highly unlikely	◯	◯	◯	◯	◯	Very likely

7. If not JC, call 3 belongs to which species?

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Call 4 - 04/12/2019 - 09:30hrs

http://youtube.com/watch?v=-1jE1-b30r4
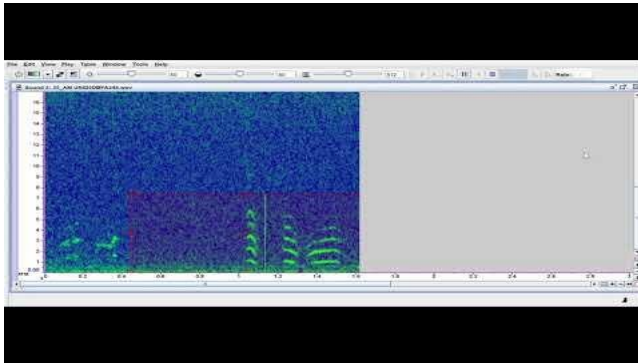
8.   How likely do you think call 4 belongs to JC

Mark only one oval.

|	1	2	3	4	5	
Highly unlikely	◯	◯	◯	◯	◯	Very likely

9.   If not JC, call 4 belongs to which species?

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SUPPLEMENTARY TABLE 2. Co-occurring bird species that vocalize within Jerdon's courser call band and picked up by the template detector in Raven Pro and Kaleidoscope.

| Sr. No	Species	Diurnal/nocturnal
1	Bay-backed Shrike *Lanius vittatus*	Diurnal
2	Black Drongo *Dicrurus macrocercus*	Diurnal
3	Common Hawk-Cuckoo *Hierococcyx varius*	Diurnal
4	Common Tailorbird *Orthotomus sutorius*	Diurnal
5	Grey Francolin *Francolinus pondicerianus*	Diurnal
6	Grey Junglefowl *Gallus sonneratii*	Diurnal
7	Grey-breasted Prinia *hodgsonii*	Diurnal
8	Indian Nightjar *Caprimulgus asiaticus*	Nocturnal
9	Indian Peafowl *Pavo cristatus*	Diurnal
10	Indian Thick-knee *Burhinus indicus*	Nocturnal
11	Jerdon's Nightjar *Caprimulgus atripennis*	Nocturnal
12	Jungle Nightjar *Caprimulgus indicus*	Nocturnal
13	Jungle Prinia *sylvatica*	Diurnal
14	Oriental Magpie-Robin *Copsychus saularis*	Diurnal
15	Pied Cuckoo *Clamator jacobinus*	Diurnal
16	Red-wattled Lapwing *Vanellus indicus*	Diurnal/nocturnal
17	Rose-ringed Parakeet *Psittacula krameri*	Diurnal
18	Savanna Nightjar *Caprimulgus affinis*	Nocturnal
17	Shikra *Accipiter badius*	Diurnal
20	Sirkeer Malkoha *Taccocua leschenaultii*	Diurnal
21	Streak-throated Woodpecker *Picus xanthopygaeus*	Diurnal
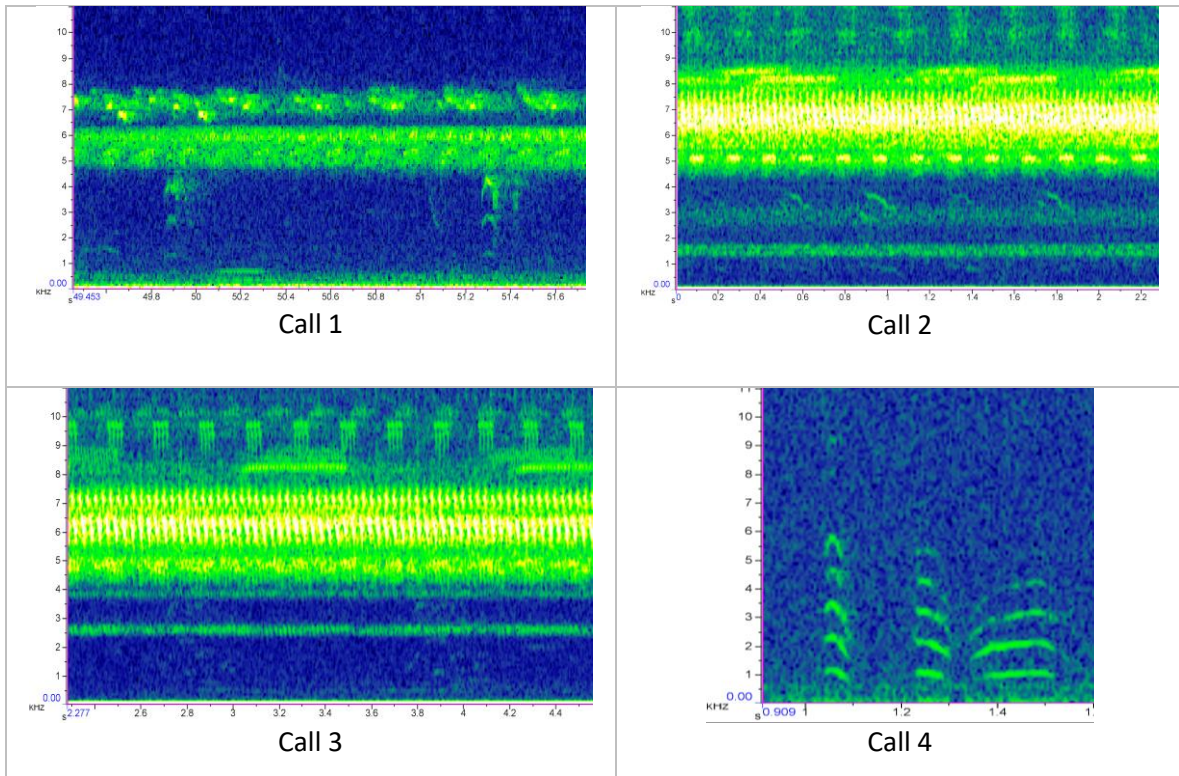
SUPPLEMENTARY FIG. 2 . Spectrograms of the four unknown calls identified by the template detector and sent for expert verification. Call 4 was considered most likely to be that of Jerdon's courser.

SUPPLEMENTARY TABLE 3 The values of the Spectral Cross-Correlation performed between the di-syllabic call of Jerdon's courser (JC) and the tri-syllabic putative call that was tagged by experts as most likely to belong to Jerdon's courser.
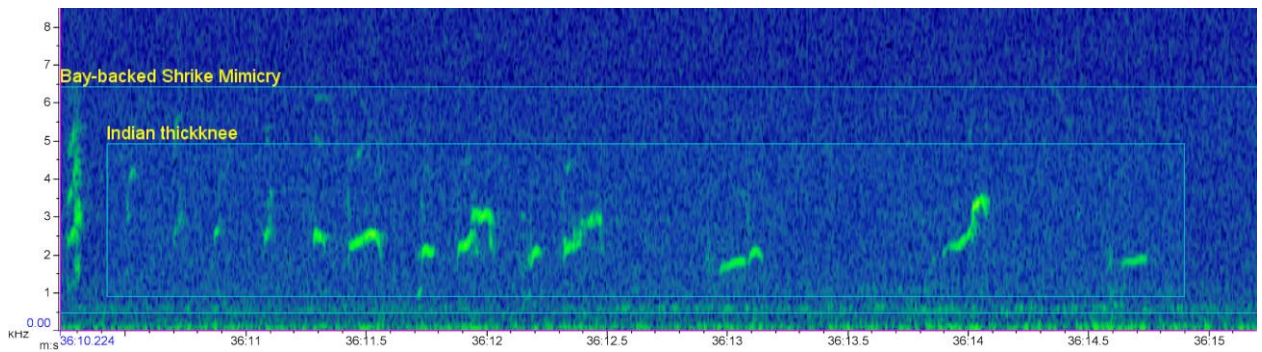
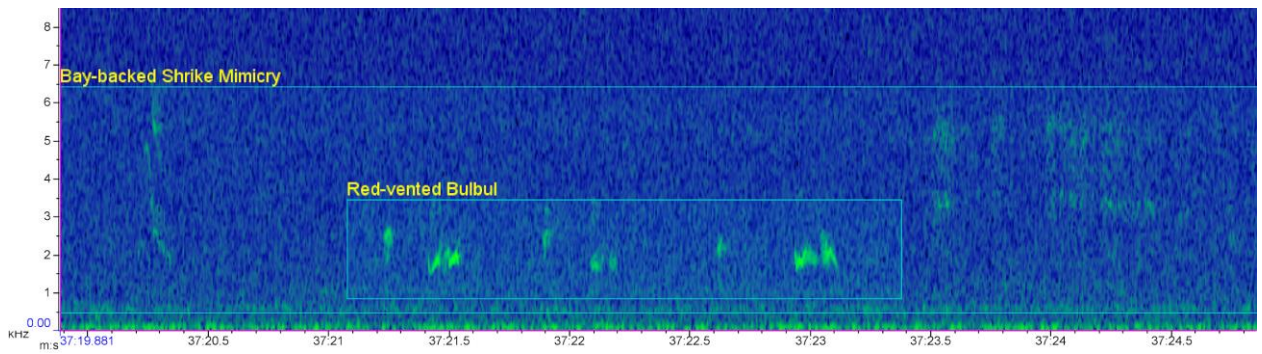|	JC_Note_1	JC_Note_2
Unknown Call4_Note1	0.591	0.402
Unknown Call4_Note2	0.504	0.454
Unknown Call4_Note3	0.383	0.534
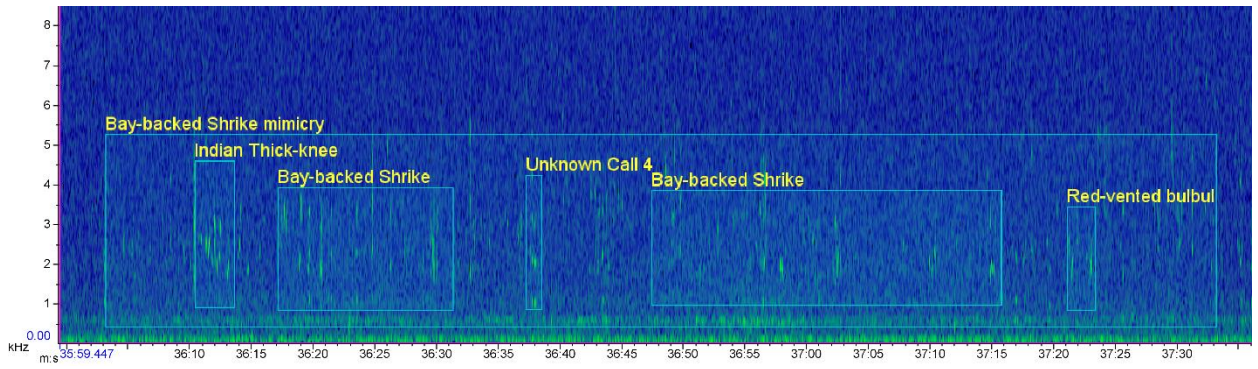
Panel 1
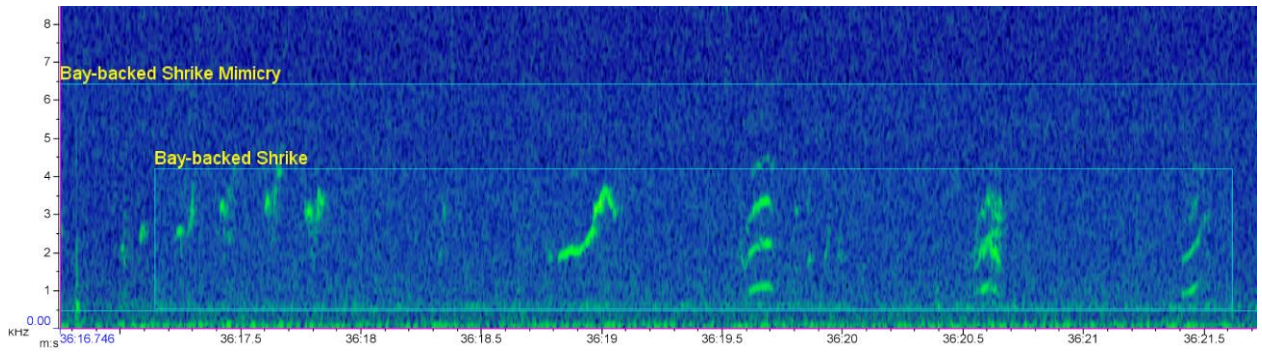
Panel 2

Panel 3

Panel 4

SUPPLEMENTARY FIG. 3 Spectrogram showing calls around the unknown call 4 (Panel 1). The spectrogram predominantly covers the calls of the bay-backed shrike (Panel 2) and includes calls of the Indian stone-curlew (Panel 3), unknown Call 4 and the red-vented bulbul (Panel 4). We suspect that the unknown call 4 might be a result of mimicry by the bay-backed shrike
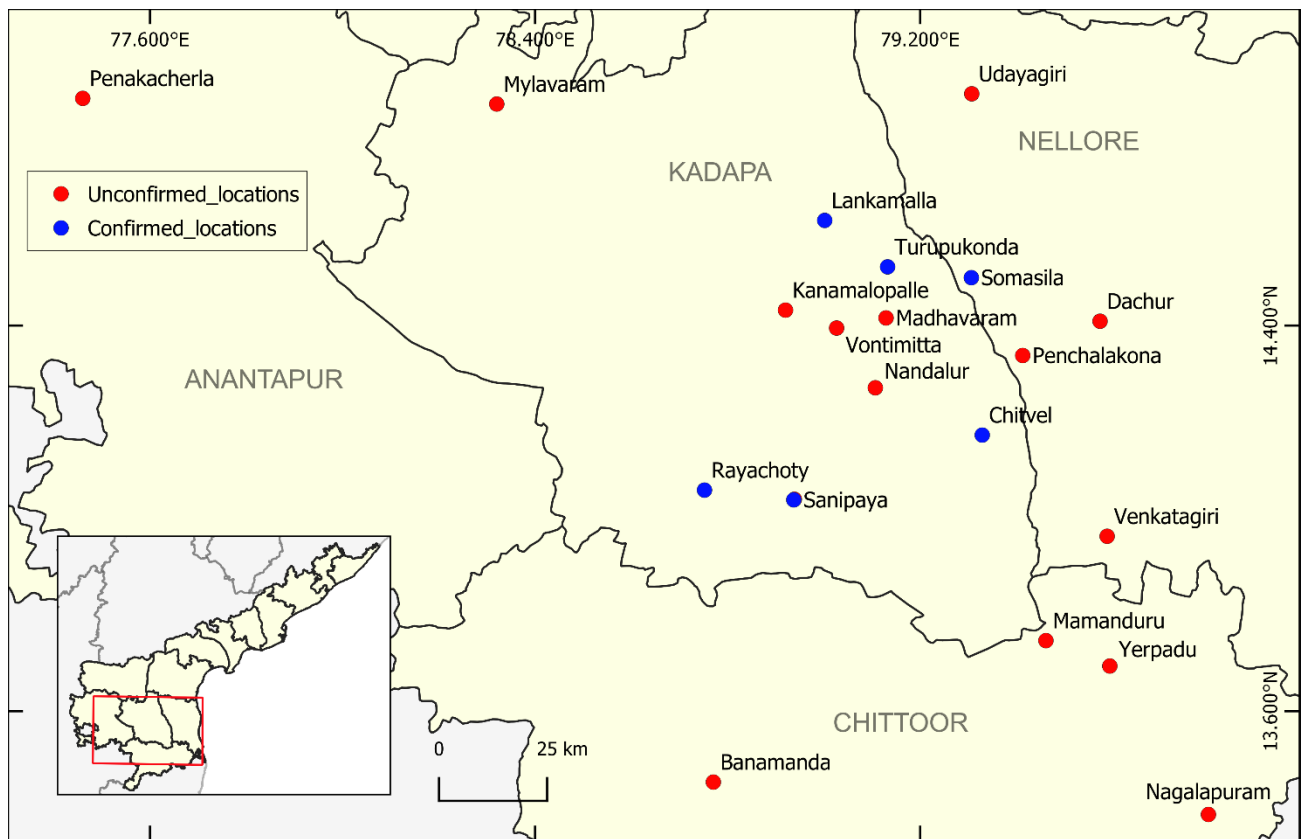
SUPPLEMENTARY FIG. 4 The inset map shows the district map of the state of Andhra Pradesh in India (in yellow). The main map shows the unconfirmed (red) and confirmed (blue) records of the Jerdon's courser from 1986–2000. Map based on Bhushan (1994) and Jeganathan, P. (2006).

SUPPLEMENTARY FIG. 5 Inaccurate news stories indicating the discovery of the call of Jerdon's courser by our team in (a) The Hindu, 4 March 2020, (b) Saakshi (Telegu), 14 March 2020, and (c) The Hindu, 14 October 2020.

References

Darras, K., Furnas, B., Fitriawan, I., Mulyani, Y. & Tscharntke, T. (2018) Estimating bird detection distances in sound recordings for standardising detection ranges and distance sampling. *Methods in Ecology and Evolution*, 9, 1928–1938.

MacLaren, A.R., Crump, P.S., Royle, J.A. & Forstner, M.R.J. (2018) Observer-free experimental evaluation of habitat and distance effects on the detection of anuran and bird vocalisations. *Ecology and Evolution*, 8, 12991–13003.