

Distribution of Sri Lanka Frogmouth *Batrachostomus moniliger* in India

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ABSTRACT

The Sri Lanka Frogmouth (*Batrachostomus moniliger*) is an elusive nocturnal bird whose distribution is known to be restricted to the forests of the southern Western Ghats of India and Sri Lanka. Following several sporadic sightings reports of the species north of its known range, we conducted a survey between 12th March 2011 and 10th April 2011 to determine its presence. Random areas in the northern Western Ghats were selected and regions of earlier sightings were surveyed. Call playback survey technique was employed on predetermined transects and calls were played every 200 m and responses by frogmouths were recorded. We recorded 51 individuals from 28 locations in a 10 km² area. We attempted to maximise visual identification and to establish with maximum certainty the sex of the bird. All detected frogmouths were found only in one of the three surveyed areas. We consider the recent sightings to be the result of a change northwards in the distribution of the species owing to climate change.

Keywords: Frogmouth, *Batrachostomus moniliger*, Western Ghats, India, distribution.

INTRODUCTION

The Sri Lanka Frogmouth (*Batrachostomus moniliger*) is a crepuscular/nocturnal forest bird endemic to South Asian, categorized as Least Concern in the IUCN red list, and in India is listed in schedule 1, part 3 (birds) of the Indian Wildlife Act of 1972 (see review in Mahabal *et al.*, 2016). Not much is known about this bird due to its nocturnal habits, preference for dense jungle tracts and cryptic colouration. Its known distribution is in disjunct populations along the Western Ghat mountains in India from Goa south up to Sri Lanka (Holyoak 2001, Rasmussen and Anderton 2005; Fig. 1). However, sporadic sightings are also reported from Uttar Kannada district in Karnataka (Borges 1985) and from Radhanagari Wildlife Sanctuary in Kolhapur district of Maharashtra (Giri 2002) and recently from further north in the Sanjay Gandhi National Park, Mumbai (Kasambe 2012). Kasambe (2012) undertook the study following reports of VD from Phansad Wildlife Sanctuary and Alibaug in 2009, and which are located between Kolhapur and Mumbai.

Mahabal *et al.* (2016), who mapped the known distribution based on collating electronic and published sightings of the study species, stressed the importance of filling the gaps in our knowledge of this endemic species. Hence, we undertook a survey to assess the presence of the species outside the known distribution and to fill the gap in the Raigad District to the west of the Western Ghats and Pune District to the east. The aim of our study was to verify the presence or absence of the

species in these regions and to try and evaluate the possible distribution of the species with predictive-modelling analyses as suggested by Kasambe (2012) and Mahabal (2016).

MATERIALS AND METHODS

We conducted an active auditory playback survey (Gerhardt 1991, Gregory *et al.*, 2004, Kemp, *et al* 2009) because individuals of both sexes of the Sri Lanka Frogmouth are known to respond to the broadcast of their respective calls (Rasmussen and Anderton 2005, Barve 2010, Kasambe 2012; Fig 2a, b). Also, because the species is known to breed between January - April (Holyoak 2001), the survey was conducted over 4 weeks between 12th March and 10th April 2011. GPS coordinates were recorded at each playback location to evaluate the distance between pairs. We conducted 10 transects of 1 km² each. This area was surveyed simultaneously by three teams - one in the centre and two parallel on each flank at 500 m distance from the central line transect.

Survey Area

To determine the sites for conduct optimal auditory transects we studied existing literature and previous records to identify the habitats to be included in our transects. The habitat of Sri Lanka Frogmouth is described as dense evergreen forest and secondary jungles with thick bamboo (Holyoak 2001, Ali and Ripley 2003, Rasmussen and Anderton 2005). We also

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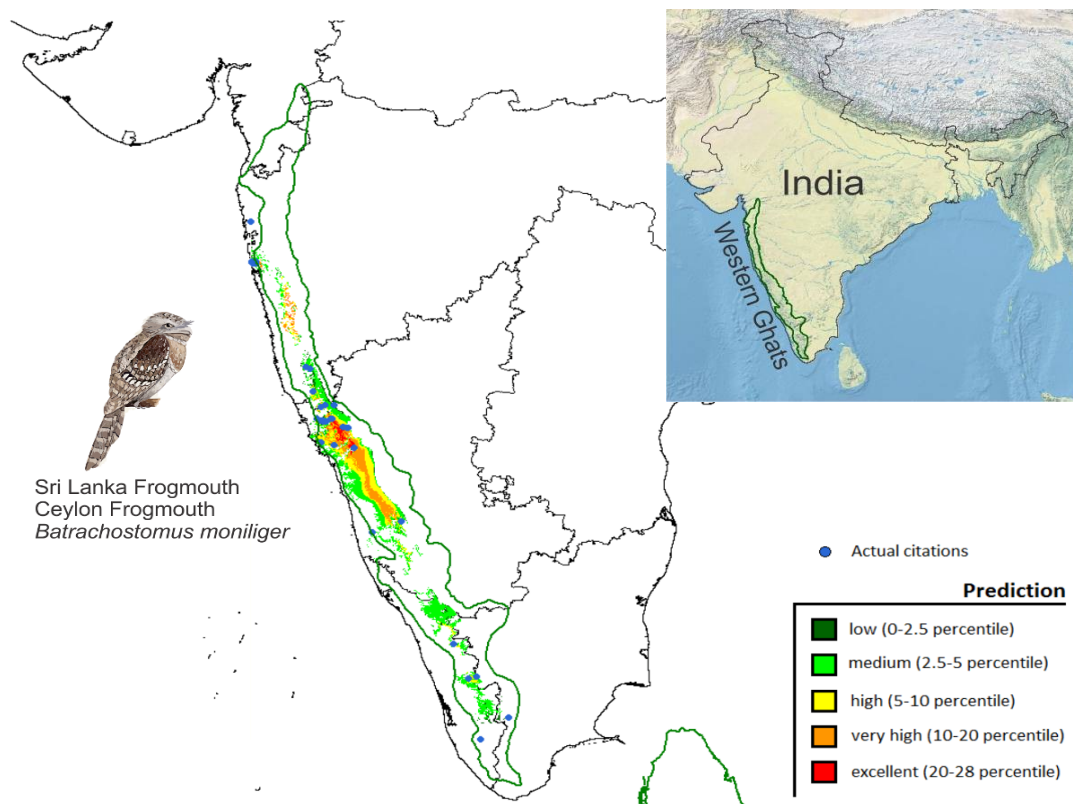


Figure 1. Known observations ($n = 56$, blue dots), and the varying degrees of predicted distribution of the Sri Lanka Frogmouth (*Batrachostomus moniliger*) in peninsular India.

evaluated with GIS the habitats (Fig 3) and proximity to humans (Fig. 4) of known observations of the Frogmouth. Based on this description we identified the key areas with the greatest potential in the Raigad and Pune districts of Maharashtra in the northern Western Ghats. The areas surveyed were the Mulshi-Tamhini Ghat region, and the Bhimashankar Sanctuary and surroundings in Pune District; and the Phansad Sanctuary and surroundings in Raigad District, where previously VD had seen a pair in 2009.

The Western Ghat mountain range is a biodiversity HotSpot of global importance (Collar *et al.* 1994, Bossuyt *et al.* 2004) and recognised as a World Heritage Site by UNESCO (<http://whc.unesco.org/en/list/1342>).

Call Playback and analysis

In our auditory surveys, our recordings from the known sites in the southern region of the distribution of the Sri Lanka Frogmouth (Fig. 2a, b), were broadcast using Apple ipod attached to Altec-Lansing iM-237 portable speakers. Speakers were positioned 3-5 feet above ground with the volume set such that a human ear could hear the call at a distance of 100 m. The playback started at sundown and was repeated every 200 m. At every playback, we waited for a response for 5 min. If we heard a return call, an effort was made to identify the gender of the responding bird.

The calls of 25 males and 26 female frogmouths, perched about 3 - 4 m above ground on a horizontal vine and from a distance of about 3 m, were recorded on a digital recorder using a parabolic microphone (e.g., Fig. 2a, b). The male and female frogmouths were usually seen perched within 5 m of one another.

Calls from 15 individuals from 28 locations were analysed using Raven Pro software (Cornell Lab). A number of notes in each call, duration of each note, inter-note time, pitch and frequency of calls were analysed.

Predictors

In addition, in order to construct the best predictors of the distribution of the Sri Lanka Frogmouth, we mapped GPS coordinates of the 56 confirmed sightings from the Western Ghats. We used DIVA-GIS to overlay the point localities on altitudinal and 19 bioclimatic parameters and human population density (Fig. 3a, 4a), at a resolution of 1 km² and modelled the distribution of the species along the environmental gradients (Fig 3b, 4b). We assumed that only breeding adults respond to the playback call, i.e., they display a degree of territorial behaviour in the vicinity of their nest site. In this manner, we hope to identify if the study species is able to co-occur with humans and also to identify their potential geographic distribution.

RESULTS

In our survey, the Sri Lanka Frogmouth was detected only to the west of the Western Ghat mountain range, at Phansad. The remaining two sites were negative for their occurrence. We recorded 51 individuals from 28 locations in a 10 km² area (10 grids of 1 km² each). Most individuals responded to the playback almost immediately after playing the call, within 10 to 60 sec of the playback. Of the 51 records, 25 frogmouths were visually recorded, of which 11 were pairs that were perched together. Based on both the visual and auditory observations, a total of 19 pairs were recorded. Total of 25 males

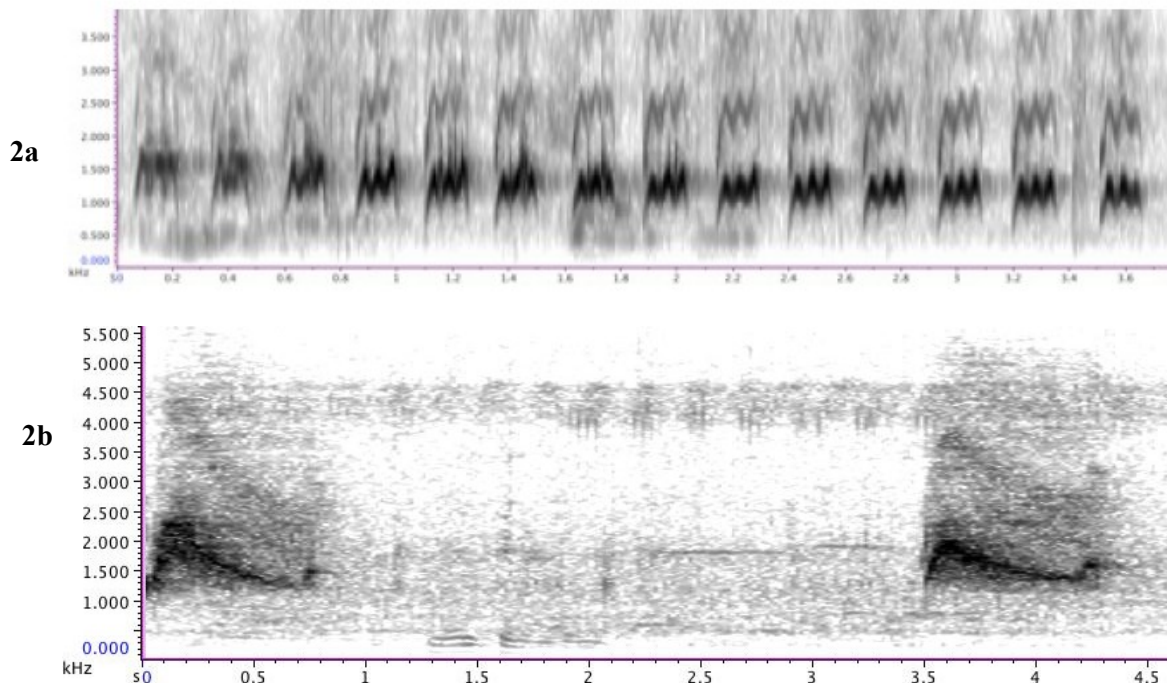


Figure 2. Sonogram of Frogmouth. 2a. Male, 2b. Female

and 26 females were recorded by auditory surveys and visual sightings and sex ratio was not significantly different from 1:1 [Square value = 0.02 (P=0.88) (Sum [Observed value -Expected value]* / Expected value)].

The birds responded from dense thickets, where they would not be ordinarily seen either during diurnal or night surveys, particularly considering their cryptic coloration. The vegetation where the birds perched consisted mainly of trees like *Millettia pinnata* (Karanj or Indian Beech), *Mangifera indica* (Mango), *Syzygium cumini* (Jamun), *Lagerstroemia microcarpa* (Anjan), *Terminalia arjuna* (Arjun) and *Lagerstroemia microcarpa* that were covered with evergreen climbers imparting more than 90% canopy cover. During the day the birds roosted under this dense canopy. All sightings were in the proximity of perennial water streams within 200 m from the nearest stream.

Habitats in which the frogmouths (n=51) were recorded were an evergreen forest (n=15), moist deciduous forests (n=8), shrubs (n=7), at the edge of a water body (n=3), or in a mosaic of all above habitats (n=18). The altitude of all the birds was less than 200 m ASL, with average annual rainfall of 2500 to 3500 mm and average annual temperature ranging between 24 - 28 °C. The male's call consists of multiple notes and each note is made of three rapid over slurred sounds *Kwa-huk, kwa-huk, kwa-huk* (Fig 2a). The frequency range of the call was between 950 Hz and 500 Hz on the lower end and 1.8 KHz and 1.4 KHz on the higher end. The notes at the beginning of the call started at a higher pitch and subsequent notes gradually started from lower frequencies as the call proceeded. The call had 14 notes which were uttered with the bird looking upward while moving the head. Each note lasted about 0.1575 sec and total duration of the call was 3.605 sec. The gap between two notes is about 0.1065 sec. All notes were quite similar to each other.

We mapped the GPS coordinates of the previously confirmed sightings (N = 57), used DIVA-GIS to overlay the point localities on vegetation and landcover parameters (Fig. 3a) and human population density (Fig. 4a). The largest number of the Sri Lanka Frogmouth was found in mosaic habitats (40.4%) and in evergreen patches (26.3%), and smaller numbers were found in deciduous forest (15.8%), shrubs (14.0%), or at a water body (3.5%; Fig. 3b). Further, the species was found in the proximity of low human densities (0-400,000, 89.5%) and the numbers decreased greatly (10.5%) with increasing human density (Fig. 4b).

Our predictive modelling suggests that in India the species is restricted to the small strip to the west of the Western Ghats. It appears to have a fragmented distribution and is concentrated in the central Ghats in northern Karnataka, Goa, and Maharashtra. Importantly, these are the localities that were previously overlooked. Most of the predicted habitats of occurrence are in the Protected Areas; however, some regions are likely to be outside Protected Areas Network. The species prefers low altitudes (1- 400 m ASL but may occur up to 1000 m ASL); moderate temperatures (24.7- 27.4°C), and areas with good precipitation (annual 1900 – 4000 mm). During non-rainy seasons it stays near well-watered habitats. Contrary to the prevalent belief of highly restricted distribution confined to the southern Western Ghats, our study predicts a much wider but fragmented distribution in the entire Western Ghats with a possible extension northwards into southeastern Gujarat (Fig. 1).

DISCUSSION

The Sri Lanka Frogmouth is a little-studied, secretive nocturnal bird of India and Sri Lanka. Its recent distribution and populations were unknown and were known only from sporadic observations with very few

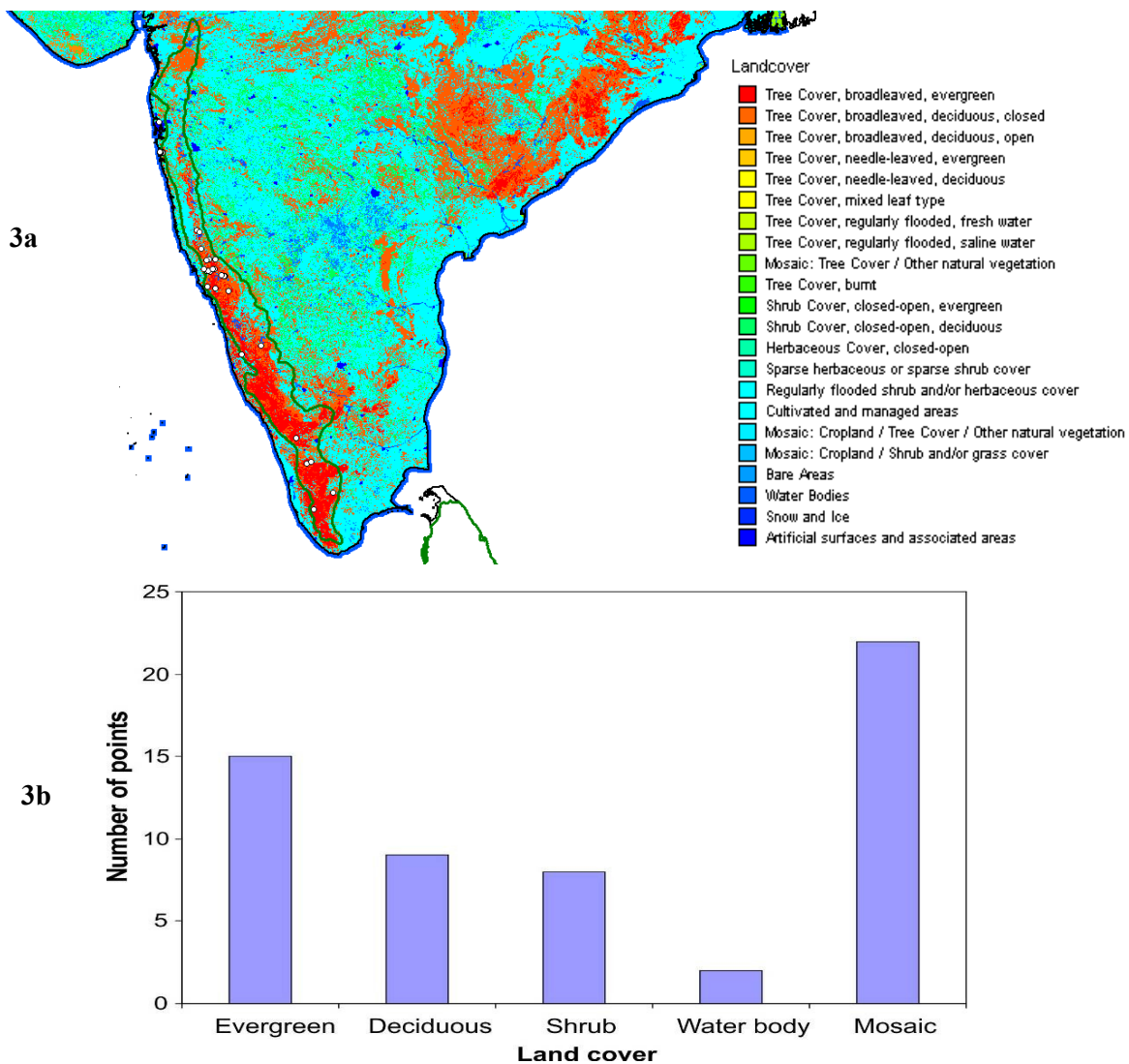


Figure 3a. The habitats of peninsular India, the known locations of the Sri Lanka Frogmouth (*Batrachostomus moniliger*), and (3b) their relative presence. Data are for pixels of 1 km².

systematic studies conducted. Our study demonstrated some of the singularities of habitat choice of the Sri Lanka Frogmouth. It appears to be a species that is sensitive to high human densities and is to be found mostly in areas with densities less than 400,000 humans/km². We also find that the species occurs in the lower altitudes, in the western fringes of the Western Ghats, i.e., from the shoreline till the lower approaches of the mountains. The species appears to prefer habitats with moderate temperatures but with a comparatively high precipitation. The combination of these parameters has allowed us to predict that the habitats to which that species could possibly extend their distribution are northwards from the presently observed populations to southern Gujarat, i.e., the northernmost extremities of the Western Ghat mountain range.

In India, till recently, the Sri Lanka Frogmouth was reported only from the southern parts of the entire Western Ghats, from the states of Kerala, Tamil Nadu and southern Karnataka. However, in recent years the number of confirmed observations has increased further to the north of its known distribution, including in this

study. We assume that the possible reasons for this change are either that awareness, in the form of more birdwatchers and ecotourists, is growing; or that the species is indeed changing its geographic distribution and spreading northwards along the Western Ghats. We argue that although the awareness has indeed significantly increased in India in the past couple of decades, that as in other regions of the world, the species is actually reacting to climate change and spreading northwards.

IPCC (2001) have reported that the global mean surface air temperatures have increased between 0.4-0.8°C and have occurred in two separate periods, 1910–1945 and since 1976. Parmesan & Yohe (2003) conducted a global meta-analysis study that included a wide range of taxa and confirmed significant shifts of species distributions toward the poles. Root (1988) established that the ranges of the bird species of North are dictated by temperature. Hence, because geographic changes in species distributions in the northern hemisphere is expected northwards, to the cooler climates, is one indicator of global climate change. Thomas & Lennon (1999) were amongst the first to demonstrate that indeed this was the fact and that in a comparison of multiple species of birds in Great Britain exhibited a northward distribution expansion, and that closely followed a period of global warming. Similarly, Hitch and

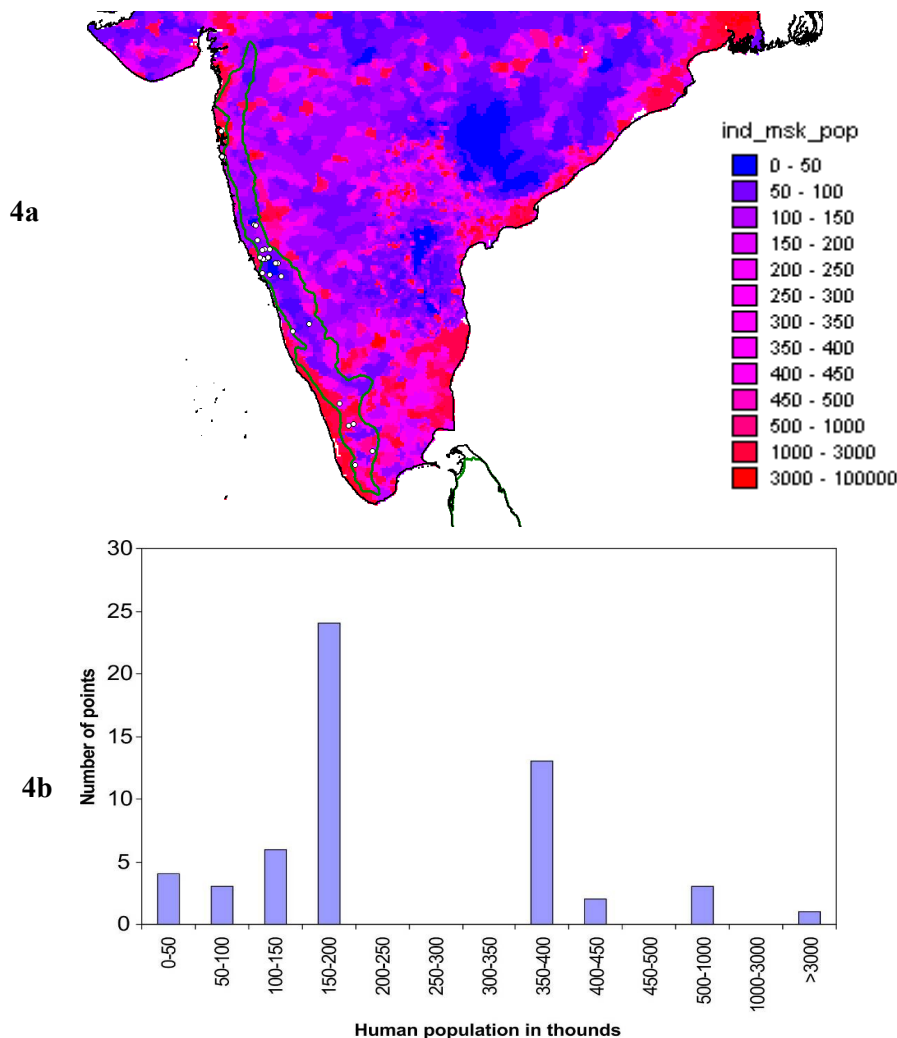


Figure 4a. The distribution of human density of peninsular India, the known locations of the Sri Lanka Frogmouth (*Batrachostomus moniliger*), and (4b) their relative presence.

Leberg (2007) examined the distribution data of 56 bird species evaluating all directional expansions. They found that there was no southward expansion of birds with a northern distribution, but the northern limit of birds with a southern distribution showed a significant shift northward of 2.35 km/year. Hitch and Leberg (2007) concluded that the northward shift observed in Great Britain and North America and its coincidence with a period of global warming suggested that it was influenced by global climate change.

The study of the effects of climate change on the Indian subcontinent has been in step with global research (e.g., Kandlikar and Sagar 1999) but are limited mostly to subjects affecting agriculture (e.g., Mall *et al.* 2004, 2006, Aufhammer 2011), public health and infectious diseases (e.g., Bhattacharya *et al.* 2006, Singh *et al.* 2011), meteorology (Dash and Hunt 2007, Guhathakurta *et al.* 2011), the media (Billett 2011), but nothing pertaining to the effects on wildlife populations or their habitats (e.g., Jathar *et al.* 2015). There are many a publication relating to the importance to the conservation of the Western Ghats (e.g., Mennon and Bawa 1997) but no study to date to understand the effects of global climate change on this sensitive habitat.

Hence, based on the studies that demonstrate the northward spread of those species with a southern distribution in two geographically disjunct areas such as the UK and North America, we too conclude with some degree of confidence that the recent observations of the Sri Lanka Frogmouth further north than its previously know distribution to be most probably

linked to the warming trend associated with global climate change.

In conclusion, we propose that the species be studied more in detail and over a greater geographic area in order to understand the changes that have indeed occurred in the species. It will also be advantageous to survey all known species like in the UK (e.g., Thomas and Lennon 1999) or USA (e.g., Hitch and Leberg 2007) in order to elucidate the rate of distributional change for all species and not only the Sri Lanka Frogmouth. These regions can then be factored in and prioritised for future conservation efforts.

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