An Annotated Checklist of the Herpetofauna of Rashtrapati Bhawan Estates, New Delhi

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An annotated checklist of the herpetofauna of the Rashtrapati Bhawan Estates, New Delhi, India

Vishal Kumar Prasad [1], Anjali Verma [2] & Ghazala Shahabuddin [3]

[1] Biodiversity Research and Conservation Foundation, 73 Gulmohar Colony, ITI Road, Satara, Maharashtra 415002, India
[2] House No. 184, Doiwala, Dehradun, Uttarakhand 248140, India
[3] Centre for Ecology, Development and Research, 201/1 Vasant Vihar, Dehradun, Uttarakhand 248006, India
[1] vishalprasad.wildlife@gmail.com, [2] anjleeverma@gmail.com, [3] ghazala303@gmail.com

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Abstract: Rashtrapati Bhavan Estates is a large semi-natural area comprising significant patches of secondary forest, cultivation, wetlands and parks in the heart of Delhi, the capital city of India. An inventory of herpetofauna was undertaken from May 15 to July 31, 2015, which revealed four species of amphibians and eight of reptiles. One reptilian species—Striped Keelback—was a new record for the Delhi region. In addition, secondary records of the presence of five snake species were obtained. Given the paucity of published data on natural history of the national capital, this annotated species checklist assumes importance and will be of use for urban planning and conservation.

Keywords: Amphibians, biodiversity, capital, city, reptiles, urban ecology.

Today, amphibians and reptiles are among the most threatened groups of vertebrate fauna (Böhm et al. 2013). Approximately 32.5% of amphibians and 19% of recorded reptile species are Red Listed and have been assigned threatened status (Stuart et al. 2008; Böhm et al. 2013). In addition, a large number of taxa are as yet data-deficient; therefore the actual numbers of threatened species may be higher (Stuart et al. 2008). The decline in herpetofaunal species has been caused by a variety of factors such as loss of wetland and forest habitat, climate change, over-exploitation, water pollution, and emergence of diseases (Gibbons et al. 2000; Kiesecker et al. 2001; Pounds et al. 2006; Sodhi et al. 2008; Thomas & Biju 2015; Nowakowski et al. 2017).

India has an immense diversity of herpetofauna, as with most other taxa and is recognized as a mega-diversity country. At present, there are 417 amphibian species in India (AmphibiaWeb 2018; Frost 2017). Further, between 533–696 reptile species are found in India (Aengals et al. 2011; Palot 2015; Uetz et al. 2017). The hotspots for herpetofaunal diversity within India are located in the Himalaya, Indo-Burma region, Nicobar Islands and the Western Ghats (Myers et al. 2000; Biju 2001; Biju & Bossuyt 2003; Mittermeier et al. 2004). Herpetofaunal taxa, however, are distributed in all the biomes in India from grasslands to the high Himalaya.

Green areas in urban centres and suburbia can be

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important refuges for herpetofaunal diversity too (e.g., Purkayastha et al. 2011). Remnant forests, riverbanks, home gardens, recreational parks and even used wetlands in urban areas, harbour much herpetofauna (Purkayastha et al. 2011; Banville & Bateman 2012), but such habitats remain largely unstudied in India. It is important to understand the distribution of herpetofauna in both modified and natural ecosystems within cities, so that they can be managed for enhanced conservation (Banville & Bateman 2012). Further, various herpetofaunal taxa have been found to be good indicators of ecosystem stress and habitat condition (Welsh & Ollivier 1998; Smith & Rissler 2010). Studies of herpetofauna in stressed environments such as cities can provide insights into their utility as indicators of habitat condition for particular biomes.

The Rashtrapati Bhawan and its surrounding green areas (hereafter referred to as Rashtrapati Bhavan Estates or RB Estates) was created in the 1920s as a residential area for the erstwhile Viceroy of India in the city of Delhi. Today it serves as the home and secretariat of the President of India. Located centrally in New Delhi, the RB Estates comprises extensive green spaces such as forests, parks, fields, and water bodies forming an interconnected mosaic of natural and artificial habitats (Baviskar 2016). The RB Estates has had limited faunal research so far.

There were limited studies of herpetofauna of Delhi region for a long time, with field studies being few and far between. A publication by Kalpavriksh (1991) compiled the first species list which shows two species of amphibians and 14 of reptiles, based largely on unidentified secondary sources. In 1997, the Zoological Survey of India, in its periodical report for Delhi, reported seven species of amphibians and 25 species of reptiles, based on field surveys in a large number of localities throughout the city. A noteworthy new species record was published by Narayanan & Satyanarayan (2012). During the last decade, scientists have been conducting more intensive surveys in various parts of Delhi including Jawaharlal Nehru University Campus, Asola-Bhatti Wildlife Sanctuary, Aravalli Biodiversity Park and Yamuna Biodiversity Park (Surya Prakash pers. comm. 10 October 2016; Delhi Development Authority 2016). It is necessary to extend field surveys to other locations within Delhi so that a more complete understanding of the city's herpetofauna can be obtained. The present study is therefore an important step towards documentation of Delhi's herpetofauna based on primary surveys.

The objective of the current study is to inventory the herpetofauna in various habitats present in the green areas of RB Estates. We present here an annotated checklist of species with notes on local abundance and ecology.

Materials and Methods

The present study was carried out from 15 May to 31 July 2015, in the Dalikhana complex of the RB Estates, which covers 24.4ha and consists of a mosaic of kitchen gardens, nurseries, ponds and remnant scrub forests.

Study Area

RB Estates (28.61401945^{0}N and 77.19366388^{0}E), has an average elevation of 230m. Covering a total of 133ha

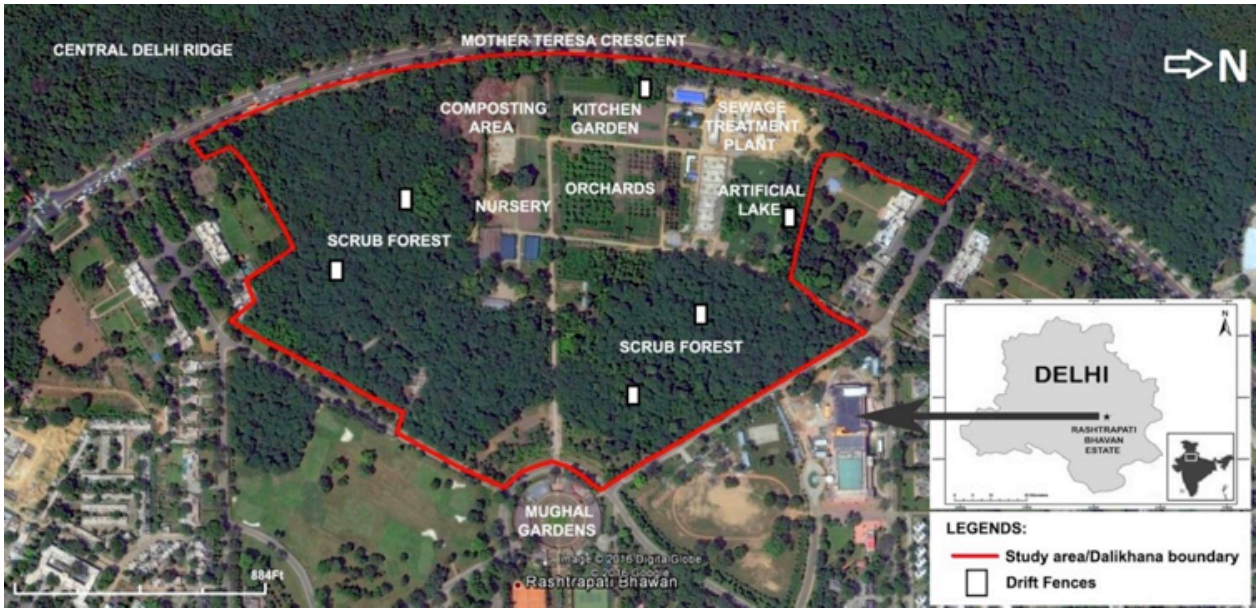

Figure 1. Map of study site in Rashtrapati Bhavan Estates showing habitat types and drift fence locations

today, the RB Estates were carved out of the last outposts of the Aravalli Hills inside Delhi, and are considered to historically have been a part of the Central Delhi Ridge forests (Baviskar 2016). Since the 1980s, the forests of the RB Estate have been largely cut off from the Central Ridge due to city roads and growing traffic (Shahabuddin 2016).

The historic Mughal Garden, which is mainly ornamental and therefore manicured, is located next to the main office building of RB. The other residential gardens and ornamental herbal gardens are also intensively managed areas. Along with the Mughal Gardens, these areas are also off-limits to researchers due to security reasons.

The remnant scrub forest patches and adjoining kitchen gardens of the RB Estates, however, form an inter-connected complex of 24.4ha (hereafter referred to as Dalikhana complex), which was found to host a diversity of birds, spiders and insects during surveys in 2014 (Shahabuddin 2016; refer to Fig. 1). This area was therefore surveyed intensively for herpetofauna during the current study.

Within the Dalikhana complex, the kitchen garden area includes vegetable patches, flower nurseries, fruit orchards, greenhouses, compost processing areas, tree plantations, weedy fallow areas, an artificial lake and a sewage treatment plant, covering an approximate area of 8ha (Fig. 1). Overall, the kitchen garden area has a moderate canopy cover of fruit and other trees, dense understorey and high diversity of seasonal weeds and flowers where rich insect diversity was recorded in 2014 (Shahabuddin 2016).

The scrub forest patches of the Dalikhana complex cover 16.4ha, have dense canopy cover and are dominated by old trees of *Prosopis julifliora*. Scattered trees of native species such as *Diospyros cordifolia*, *Acacia modesta*, *Ehretia laevis, Acacia leucophloea* and *Acacia catechu* are also present (Shahabuddin 2016). The forest has a thick bushy understorey mainly comprising native shrub species such as *Adhatoda vasica*, *Capparis sepiaria* and *Grewia tenax*. Seasonal herbaceous vegetation is composed of native species such as *Dipteracanthus prostrata*, *Abutilon indica*, *Barleria cristata* and *Plumbago zeylanica*. Water leaks from the artificial lake, sewage pipes and the sewage tanks often form temporary swampy areas within the forest patches, which are of importance to fauna (Shahabuddin 2016). These low-lying swampy areas are also flooded during heavy rains.

Methods

Multiple techniques were used for the study. Firstly, active visual searches were carried out for reptiles and amphibians during the daytime (06.30–09.30 hr) and during night (from 18:00hr until 24:00hr midnight) for an average of three days each week. Apart from passive observation, active searches were carried out in leaf litter, rocky outcrops, under rocks, inside abandoned buildings, on tree trunks and shrubbery, greenhouses, damp soil, flowerpots, artificial ponds and temporary rain puddles. Burrowing herpetofauna were searched for by digging up the soil in likely spots and pulling up stones and fallen logs (following Vasudevan et al. 2008; Kamei et al. 2009). Individuals were photographed in their natural habitats where possible. All opportunistic sightings were also taken into account for developing the final checklist as a few species were encountered while walking from one site to another. Sloughed off snakeskins, when encountered, were collected and used to identify species present in the area.

Second, six drift fences (each 10m in length combined with two large pitfall traps of 35cm diameter and 50cm depth at each end) were installed in different parts of the study area including the vegetable garden, scrub forest patches and near marshy/pond areas for two months (Refer to Fig. 1 for the locations). Drift fences are effective for inventorying and monitoring diverse species of herpetofauna (Todd et al. 2007). A pitfall trap is a catch pit for small animals, such as reptiles-geckos, lizards, skinks, snakes, frogs and toads (Enge 1997, 2001). The traps were checked three times a day—morning (06:30hr), evening (19:00hr) and at night (23.30hr)—for any trapped animals.

Trapped individuals of reptiles and amphibians were photographed, their morphological features were noted for identification, and subsequently released. Salient morphological characters of anurans such as snout profile, webbing in feet, finger/toe tip dilation, tympanum size, external colouration, digging apparatus, vocal sacs, pupil-iris, skin texture, key feature on head, limbs were noted (following Daniel 2002; Gururaja 2012). For reptiles, identification features such as head-body shape, head-body-subcaudal scale count, finger morphology, types of scales, sex pores, warts and tubercles were recorded (Whitaker & Captain 2004; Giri & Bauer 2008). Species were identified using several different guidebooks and research papers (Daniel 2002; Das et al. 1998; Whitaker & Captain 2004; Vasudevan & Sondhi 2010; Gururaja 2012).

In order to obtain secondary information, four gardeners working in the area were interviewed regarding observations on herpetofauna, their occurrence/abundance in the past and any recent sightings. Two of these informants had spent more than 20 years in the RB Estates. Colour pictures from Whitaker & Captain (2004)

were shown to the interviewee to confirm identification of the species that they reported to us.

Results

During our primary surveys, eight species of reptiles from six families and four species of amphibians from three families were reported. Interviews with local workers reported five additional species. In this paper, only the 12 species sighted and photographed by the researchers during the surveys, are described (primary sightings). The annotated checklist of species follows.

Amphibians

Family Bufonidae Gray, 1825

Indian Common Toad *Duttaphrynus melanostictus* (Schneider, 1799): In RB Estate, only a single individual was sighted in the weedy areas adjoining the artificial pond the day after pre-monsoon showers in the first week of June 2015. It is inexplicably rare in the study area in comparison to its congener *D. stomaticus* (see below).

Marbled Toad *Duttaphrynus stomaticus* (Lütken, 1862; Image 1): This is a medium-sized toad of arid and semi-arid areas and has been historically reported from Delhi region (Kalpavriksh 1991). Its current status in the Delhi region, however, is not well understood. In this study, we sighted it frequently at night, after the beginning of the rains.

We observed individuals of *D. stomaticus* in large congregations in a small shallow pond in Dalikhana area from 20.00hr until midnight on 16 May 2015, after a bout of heavy rain. The males were gathered in a close group and called loudly in a chorus from a temporary pond. The females arrived later than males. At this time, we observed the males were brightly lime-yellow in colour and females were slightly darker in coloration. The males outnumbered the females in the pond and were competing by pushing and kicking one another. Two males were observed clasping other moving males in the pond but clasped males were released after vibrations and jolts (Hettyey et al. 2005). Further, lone males tried to displace pairs already in axillary amplexus (see image 1). One female was seen dead of exhaustion after carrying a male around for some time. The breeding period lasted for four to five days.

The next day, thousands of eggs were seen and in approximately two-three days, tadpoles were also seen in the lentic water of pond. No egg attendance or parental care for tadpoles was seen (Wells 2007).

Family Dicroglossidae Anderson, 1871

Indian Burrowing Frog *Sphaerotheca* spp. (Gunther, 1859; Image 2): This species was sighted three times during the survey during the monsoon. The first individual was observed feeding on mosquito larvae near a small marshy pool in the kitchen garden area in mid-May. Another calling male was found in an artificial pond under a bunch of lotus leaves in the Spiritual Gardens of RB Estate. On the third occasion, two individuals were seen near the same lotus pond.

Family Microhylidae Günther, 1858

Ornate Narrow-mouthed Frog *Microhyla ornata* (Duméril & Bibron, 1841; Image 3): This species was sighted only twice. One individual was sighted at night very close to a temporary pond located in a habitat of grasses, dense shrub and tree cover in early July, soon after the commencement of the rains. A second individual was sighted the next day from the same area. The pulsatile and short advertisement calls of the pool breeder *M. ornata* (Wijayathilaka & Meegaskumbura 2016) was also heard from another spot in the kitchen-garden area after a heavy downpour on 11 July 2015 when most of the area was waterlogged.

Image 1. A pair of Marbled Toads in amplexus

Image 2. Indian Burrowing Frog near semi-dry pond

Reptiles

Family Gekkonidae Gray, 1825

Kushmore House Gecko *Hemidactylus* cf. *kushmorensis* (Murray, 1884; Image 4): This species has been clarified taxonomically very recently by Lajmi et al. (2016). It is distinguished from the sympatric Yellow-bellied House Gecko by its relatively small size, reduced lamellae on digits, dorsal tubercles (including strongly keeled tubercles on the tail) and a blotchy pattern of dark and light spots. It is currently seen occasionally in other parts of Delhi including JNU Campus (Surya Prakash pers. comm. 10 October 2016) and has been historically recorded from the Delhi Ridge (Kalpavriksh 1991).

In RB Estates, the Kushmore House Gecko was seen commonly at night in the semi-wild parts of the Estate and was observed mainly in leaf litter on the forest floor and on the lower reaches of tree trunks. It was frequently trapped in the pitfall traps too. It was rarely seen during the daylight hours. Its eggs, which are spherical and white, were observed in clusters of 3–4 buried under rocks.

Yellow-bellied House Gecko *Hemidactylus flaviviridis* (Rüppell, 1835): This is a commensal species found commonly in Delhi. In the RB Estates, it was seen in built-up areas such as offices, abandoned sheds, greenhouses, gates and concrete fixtures in the kitchen garden. There was a clear separation visible in the habitats utilised by the Yellow-bellied House Gecko that occupied the built-up areas and the Kushmore House Gecko, which was seen only in the forest and forest edge habitat.

Family Scincidae Gray, 1825

Dotted Writhing Skink *Lygosoma punctatum* (Gmelin, 1799): This is one of the most common skinks in Delhi, living in both wild and semi-wild habitats. It was found to be fairly common in RB Estates, too, with numerous individuals of varied sizes being caught in pitfall traps. It was seen in moist soft soil, leaf litter and near rocks in the kitchen garden and the scrub forest.

Family Agamidae Gray, 1827

Oriental Garden Lizard *Calotes versicolor* (Daudin, 1812): Being one of the most common reptiles in northern Indian cities, the Oriental Garden Lizard was seen frequently in the RB Estates as well. Individuals were mostly spotted on shrubs and trees or crossing the path in both the forest as well as the kitchen gardens and park areas. On two occasions, during evening, individuals were seen sleeping on shrubs, about 1m above the ground and were not disturbed by our movements.

Family Typhlopidae Merrem, 1820

Brahminy Worm Snake *Indotyphlops braminus* (Daudin, 1803; Image 5): This species has been recorded from Delhi Ridge in the past (Kalpavriksh 1991) and appeared to be common in RB Estate. They were seen 5–6 times during the course of the surveys, in loose soil under rocks, in dry leaf litter in the scrub forest and in abandoned flowerpots and construction waste. More than 10 individuals were caught in the pitfall traps and found underneath rocks. The individuals caught were between 100mm and 130mm in length. A freshly moulted individual was also spotted, having a translucent grey-blue milky appearance. After shedding its skin, it turned a lustrous dark brown.

Family Colubridae Oppel, 1811

Common Wolf Snake *Lycodon aulicus* (Linnaeus, 1754): This species has been historically recorded in Delhi

Image 3. Ornate Narrow-mouthed Frog in forest floor leaf litter

Image 4. Kushmore House Gecko on rocky substratum in the scrub forest

and is reportedly common at present (S. Prakash pers. comm. 10 October 2016), being reported in all checklists published so far. In the RB Estates, it was seen twice at night in an abandoned shed in the scrub forest. On one occasion, it was seen on a brick wall at a height of 3m above the ground, showing its agility and good climbing abilities. On one occasion, it was also seen crawling into a rock crevice. Three separate skin sloughs of Common Wolf Snake were seen in the same area where the individuals were sighted. An abundance of two species of geckos (see above), which are reportedly their major prey, could be a reason for their presence in the area.

Striped Keelback *Amphiesma stolatum* (Linnaeus, 1758; Image 6): This snake species was seen only once when a specimen was caught in a pitfall trap in the scrub forest after a bout of heavy rains. It appeared to be a fully formed adult, yet was unable to climb out of the pitfall trap (due to the slippery plastic walls of the trap). Although it is supposedly a common and widespread Indian species (Whitaker & Captain 2004), it is rare in the Delhi region (Surya Prakash pers. comm. 10 October 2016).

Family Elapidae Boie, 1827

Spectacled Cobra *Naja Naja* (Linnaeus, 1758)

The Spectacled Cobra is commonly reported from the Delhi region particularly from agricultural and semi-wild surburban areas. During the survey, it was seen only once, in the overgrown part of the kitchen garden. It was reportedly more common earlier in the RB Estates, according to the gardeners but now it is rarely seen.

Discussion and Conclusions

A total of 12 species of herpetofauna were recorded in the RB Estates in this study. The presence of five additional species of reptiles were reported by the gardening staff—the Common Indian Monitor *Varanus bengalensis*, the Common Krait *Bungarus caeruleus*, Russell's Viper *Daboia russelii*, Red Sand Boa *Eryx johnii* and the Rat Snake *Ptyas mucosa*—but were not recorded by us. Of these species, only the Rat Snake and Russell's Viper have been seen recently by the gardeners. The other three species of reptiles have not been spotted for the last few years.

One species could not be identified up to the species level (burrowing frog). Burrowing frogs (*Sphaerotheca* spp.) need revision throughout their range to solve taxonomic issues (Biju 2001). While *Sphaerotheca breviceps* was thought to be widespread and has been recorded earlier from the Delhi region (Zoological Survey of India 1997), recent studies now show the presence of genetically cryptic species that were earlier included in the *S. breviceps* species complex. Dahanukar et al. (2017) for instance, described *S. pluvialis*, a species that may earlier have been grouped with *S. breviceps*. Similarly, Padhye et al. (2017) described the species *S. pashchima* (from western India) from specimens earlier identified as *S. breviceps*. Based solely on photographs, we were able to identify the individuals of burrowing frog seen in the RB Estate only up to genus level. Specimen study will be needed to confirm the species that exists in the area.

In comparison to other surveyed areas in Delhi, the study area unearthed a low diversity of herpetofaunal species. For instance, 27 species have been recorded in Aravalli Biodiversity Park, located in south-central Delhi, and 20 species are listed for Yamuna Biodiversity Park, located in the flood plains of Yamuna in northern Delhi (Delhi Development Authority 2016).

The low diversity of herpetofauna can be partially attributed to the relatively small and isolated area of unmanaged forest and wetland habitat in the RB Estates (less than 25ha) in comparison to the two biodiversity parks. For instance the Aravalli Biodiversity Park exists

Image 5. Brahminy Worm Snake

Image 6. Striped Keelback Snake in an artificial pond at the edge of the scrub forest

over 280ha and is contiguous with a larger expanse of scrub forest while the Yamuna Biodiversity Park covers 190ha on the banks of the river Yamuna, covering both terrestrial and aquatic systems. The recorded species are themselves likely present in small remnant populations in the RB Estates, making observation much more difficult. Further, much of the cultivated area in the RB Estates is intensively managed for vegetable and flower cultivation and therefore experiences high degree of pesticide usage, cleaning and weed-removal. Such activities are likely to reduce microhabitats for herpetofauna.

On the other hand, the low number of species could also be an artefact of the short period of sampling, although care was taken to include parts of both summer and monsoon seasons in 2015. Further, the herpetofaunal lists for Aravalli Biodiversity Park and Yamuna Biodiversity Park have been developed over several years of observation. Thus it is highly likely that further work may yield additional species in the RB Estates, particularly those that are regionally rare.

The five most common species found in RB Estates were the Brahminy Worm Snake, Kushmore House Gecko, Yellow-bellied House Gecko, Marbled Toad and Dotted Writhing Skink. The Ornate Narrow-mouthed Frog, Burrowing Frog and the Striped Keelback were rare; having been seen only a few times each. The Common Indian Toad was rare even during the breeding season and was outnumbered by the Marbled Toad, which was surprisingly abundant. The current report represents the first *published* record of the Striped Keelback in the Delhi region.

Local informants reported additional species such as the Common Krait *Bungarus caeruleus*, Red Sand Boa *Eryx johnnii* and Common Indian Monitor *Varanus bengalensis*, that have been reported from the Delhi Ridge area too (Kalpavriksh 1991). The present survey, however, could not confirm the presence of the latter species. Either these species have become so rare within RB Estate as to escape detection or have been locally extirpated from the area. The latter case might be possible given the reducing area of the wild and semi-wild habitats in the RB Estates due to expanding construction and increasing intensity of management (by pruning, weeding and pesticide application). Further, the isolation of the RB Estates from the nearby Central Ridge, possibly the nearest colonising source for faunal species, could have resulted in the gradual dwindling of herpetofaunal species over the years. Some other species of conservation concern have been recorded in other parts of the Delhi Ridge such as Indian Spiny-tailed Lizard (*Saara hardwickii;* Kalpavriksh 1991) and Indian Rock Python (*Python molurus;* Surya Prakash pers. comm. 10 October 2016; Zoological Survey of India 1997), but could not be recorded in the present study.

A number of studies show that certain natural habitat features such as aquatic vegetation and habitat complexity can be critical to maintaining amphibian diversity in an urban landscape context (Parris 2006; Hamer & Parris 2011; Banvile & Bateman 2012). In the present study, too, the richest areas for the herpetofauna were the unmanaged weedy habitats in the forest and kitchen gardens of the Dalikhana, especially those having temporary ponds, moist swampy patches and good tree and shrub cover while species were largely absent from the manicured recreational areas. Therefore, in order to conserve the remaining diversity of herpetofauna, we recommend (1) strict protection of the native scrub forest remnants in the RB Estates along with their natural drainage systems, (2) chemical-free maintenance of the artificial ponds and (3) allowing spaces for natural seasonal ponds and uncultivated weedy patches inside the kitchen garden and nursery areas. Such measures will likely improve the herpetofaunal populations in the RB Estates and support their long-term conservation.

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