Communications

Species composition and abundance estimates of reptiles in selected agroecosystems in southern Western Ghats, India

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Species composition and abundance estimates of reptiles in selected agroecosystems in southern Western Ghats, India

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Abstract: Species composition and abundance of reptiles in selected agroecosystems in Thrissur plains, near Palghat Gap, southern Western Ghats in India, was studied from January 2017 to May 2017. The agroecosystems surveyed were coconut, cashew & rubber plantations, home garden, paddy field, and botanical garden. Time-constrained visual encounter surveys of a total effort of 360 man-hours were done in the field. Coconut and cashew plantations reported the highest species richness with 11 species each, while the highest number of sightings (159) were recorded from botanical garden. Bronze Grass Skink Eutropis macularia was the most abundant species in agroecosystems. Correspondence analysis was done to compare the reptilian diversity in the agroecosystems. The reptile fauna of home garden and paddy field were found to be more distinct than the rest of the agroecosystems. A total of 17 species of reptiles were recorded during the study, thus highlighting the significance of agroecosystems in acting as important buffer landscapes for reptiles.

Keywords: Cashew plantation, coconut plantation, botanical garden, home garden, Important Bird Area, Kole wetlands, paddy field, Ramsar site, rubber plantation.

Malayalam Abstract

Abstract: വെളക്കാലവരിയുമായി നടക്കുന്ന പർവ്വത പ്രദേശങ്ങളിലെ 15 ഭൂമിശാസ്ത്ര അഗ്രോ-ഇകോളജുകളിൽ കൃഷി കേന്ദ്രങ്ങളായ കോഴിക്കോട്, കുറ്റിക്കാട് & റബർ കൃഷികൾ, മാസ്റ്റർ ഗാർഡന്, ഹോം ഗാർഡൻ, പാപ്പിയഡ് ഫിൽഡ് എന്നിവയിലെ ജീവിപ്രകൃതിയുടെ ചക്രാതാവുകൾ കണ്ടെത്തി. കൊക്കിച്ച് എന്ന കൃഷിക്കലണങ്ങളിൽ 11 സ്പീഷീസ് എല്ലാവരിയിൽ ഉണ്ടായി. കൊക്കിച്ചിന്റെ കണ്ടെത്തലുകൾ എല്ലാവരിയിൽ സാധ്യതയുള്ളതാണ്. 17 സ്പീഷീസിൽ കുറഞ്ഞ പ്രായപിറിലുള്ള ഭൂമിശാസ്ത്ര അഗ്രോ-ഇകോളജാണ്. അഗ്രോ-ഇകോളജിനുള്ള പ്രായപിറിലയിലുള്ള ആധുനിക പ്രായപിറിലാണ്‌. മാസ്റ്റർ ഗാർഡന്റെ കൃഷികൾ ഒരു പ്രായപിറിലാണ്‌. ഹോം ഗാർഡന്‌ എന്നത് മാസ്റ്റർ ഗാർഡന്റെ കണ്ടെത്തലിന്റെ പ്രായപിറിലാണ്‌ പ്രായപിറിലാണ്‌. പാപ്പിയഡ് ഫിൽഡിന്റെ കൃഷികൾ ഒരു പ്രായപിറിലാണ്‌. സ്പീഷീസ് ചക്രാതാവുകളുടെ കണ്ടെത്തലിന്റെ പ്രായപിറിലാണ്‌. കൂടാതെ ജീവിപ്രകൃതികളുടെ മാസ്റ്റർ ഗാർഡന്‌ എന്നത് കൃഷികളിലെ പ്രായപിറിലാണ്‌. 

Keywords: കുറ്റിക്കാട് കൃഷി, കൊക്കിച്ച് കൃഷി, മാസ്റ്റർ ഗാർഡൻ, ഹോം ഗാർഡൻ, ഇമ്പോർട്ട് ബിർഡ് എയർജി, കോഴിക്കോട് വെള്ളാടുകൾ, പാപ്പിയഡ് ഫിൽഡ്, റബർ കൃഷി, രാമസർ സൈറ്റ് എന്നിവ.
INTRODUCTION

Nearly two-thirds of the terrestrial environment of the world is made up of managed ecosystems with natural, undisturbed habitats accounting for only a meagre five percentage. These managed ecosystems include agricultural systems, forestry systems, and human settlements (Gamage et al. 2008). Herpetofauna makes up 48% of the terrestrial vertebrates that are threatened by agroforestry and forestry activities (Palacios et al. 2013).

Despite the fact that herpetofauna makes up half of vertebrate species, they are very much understudied in their response to change in habitats from natural forests to plantations. The review done by Palacios et al. (2013) on the herpetofauna of agroecosystems on a global scale found just 27 studies pertaining to amphibians and reptiles. Very few studies on the reptilian diversity of agroecosystems have been done in southern India too. Perhaps the only study on the reptiles of human-modified habitats is the one by Venugopal (2010), who studied the agamids of human-modified habitats in the Western Ghats.

In a time when more and more forest areas are being converted into plantations and agricultural lands for meeting the growing needs of human populations, it is important to evaluate the reptile diversity in these modified ecosystems. It is important to assess whether these agroecosystems are capable of supporting and sustaining reptile biodiversity, particularly that of habitat specialists and endemic species.

STUDY AREA

The study was conducted in selected agroecosystems in Thrissur District, southern Western Ghats, Kerala (10.53°-10.55°N & 76.27°-76.28°E, 20–70 m). The agroecosystems chosen included cashew, coconut & rubber plantations, home garden, paddy field, and botanical garden (Fig. 1). The study area chosen mostly comes within the main campus of Kerala Agricultural University in Kerala. The campus has a total area of 391.44ha and is located very close to Peechi-Vazhani Wildlife Sanctuary. The major habitats include gardens, botanical gardens, plantations of rubber, coconut, plantain & cocoa, and orchards of mango, jackfruit, sapota & guava. The whole area must have been under forests about one and a half centuries ago and was subsequently converted mostly into rubber plantations. Later, in 1971, the land was handed over to the Kerala Agricultural University (KAU), and the KAU developed these areas into different land uses as explained above. The 14-year mean minimum temperature is 23.3°C and the 10-year mean maximum is 31.9°C. The area receives southwest and northeast monsoons, the greater portion of the rainfall, however, is received from the southwest monsoon between June and September. The mean...
annual rainfall is 2803.4 mm. The mean number of rainy days per year is 112 (Manohar et al. 2017). The paddy field selected was located at the Kole Wetlands in central Kerala, which incidentally is a Ramsar site and an Important Bird Area (IBA) (Islam & Rahmani 2004, 2008).

METHODS

The method followed was time-constrained visual encounter survey of a two-hour duration in each of the agroecosystems in the morning (08:00–10:00 hr) and evening (19:00–21:00 hr). Each location was covered on foot and whenever a species was sighted, observations such as the name of the species, the number of sightings, time, and GPS location were recorded following Ishwar et al. (2001). At each agroecosystem, the survey was carried out for five days. Thus, the total effort spent during the entire course of the study was 360 man-hours. Additionally, micro-habitat parameters such as canopy height, canopy cover, leaf litter depth, leaf litter cover, shrub cover, herb cover, and number of fallen logs were recorded at each of the agroecosystems. Litter depth was measured using a steel scale (Elora) and canopy height was measured using Haga altimeter (Durga Enterprises). The rest of the measurements were visually estimated (see Vasudevan et al. 2001; Kanagavel et al. 2013). Weather data like maximum temperature, minimum temperature, and relative humidity for the study period was obtained from the Kerala Agricultural University Weather Station located in Thrissur District, Kerala. The study was carried out from January to May 2017 in the pre-monsoon season.

For confirming the identification of the species, the following literature were consulted: Das (2002), Whitaker & Captain (2004), Mahony (2011), Agarwal & Karanth (2015), Agarwal et al. (2016), Lajmi et al. (2016). The distribution range of the species was verified using Ganesh et al. (2013) and Palot (2016).

Statistical Analysis

Chi-square analysis of association was performed to understand whether the reptile fauna had a preference for any plantation types (coconut, cashew, rubber, home gardens, botanical gardens, or paddy fields). Patterns of relationship between species abundance across nine environmental parameters (canopy cover, canopy height, litter depth, litter cover, shrub cover, herb cover, maximum temperature, minimum temperature, and relative humidity) in different plantation types were investigated using canonical correspondence analysis (CCA), a multivariate constrained ordination technique (Legendre & Legendre 1998). A triplot of observations grouped for plantation types, species, and eigenvectors of environmental variables was plotted to understand the species distribution along the plantation types and environmental variables. A scree plot of eigenvalues and cumulative inertia explained by each canonical axes was plotted to understand the contribution of each axes. The significance of the canonical axes was tested using permutations test (Legendre et al. 2011). Statistical analysis was performed in PAST 3.19 (Hammer et al. 2001).

RESULTS AND DISCUSSION

A total of 594 sightings of 17 species (Table 1) was encountered from the agroecosystems during the study period, with an average pooled encounter rate of 1.27 reptiles/man-hour. The species richness was the highest in coconut and cashew plantations, with 11 species each (Table 2; Images 1–14). The abundance of the reptiles, however, was greatest in botanical gardens (159 sightings). Bronze Grass Skink *Eutropis macularia* was the most encountered species in the agroecosystems of Thrissur District with 220 sightings, followed by (Murray’s) House Gecko *Hemidactylus murrayi* totalling 87 sightings.

The variation in the number of sightings of the reptiles between day and night are given in Fig. 2. As expected, it can be seen that most of the reptiles were more active during night hours. Out of the six species of geckos seen during the study, all four species of *Hemidactylus* geckos, as well as *Cyrtodactylus cf. collegolensis*, were nocturnal in habit. The Day Geckos *Cnemaspis* spp., however, as its common name suggests, were observed mainly during morning hours. Among skinks, *Ristella cf. beddomii* was primarily a nocturnal species, while *Sphenomorphus dussumieri* was spotted only during day hours. *Eutropis macularia, E. carinata*, and the agamid lizard *Calotes versicolor* were observed during both morning and night hours. *Calotes versicolor* was observed to be sleeping when spotted during night hours. All the seven species of snakes observed were spotted during night hours (Fig. 2).

There was a significant association between plantation types and abundance of different reptile species (chi square = 1006.3, df = 80, P < 0.0001), indicating that the reptile fauna had a differential preference for the plantation type. The complex pattern of reptile species distribution across the plantation types
Table 1. Reptiles of selected agroecosystems in Thrissur District

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Family</th>
<th>IUCN status</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Murray’s) House Gecko</td>
<td>Hemidactylus cf. murrayi</td>
<td>Gekkonidae</td>
<td>NE</td>
<td>Image 1</td>
</tr>
<tr>
<td>2 Common House Gecko</td>
<td>Hemidactylus frenatus</td>
<td>Gekkonidae</td>
<td>LC</td>
<td>Images 2 &amp; 3</td>
</tr>
<tr>
<td>3 Termite Hill Gecko</td>
<td>Hemidactylus triedrus</td>
<td>Gekkonidae</td>
<td>NE</td>
<td>Image 4</td>
</tr>
<tr>
<td>4 Day Gecko</td>
<td>Cnemaspis cf. gracilis</td>
<td>Gekkonidae</td>
<td></td>
<td>Images 5 &amp; 6</td>
</tr>
<tr>
<td>5 Kollegal Ground Gecko</td>
<td>Cyrtodactylus collegalensis</td>
<td>Gekkonidae</td>
<td>NE</td>
<td>Image 7</td>
</tr>
<tr>
<td>6 Dussumier’s Litter Skink*</td>
<td>Sphenomorphus dussumieri</td>
<td>Scincidae</td>
<td>LC</td>
<td>Image 8</td>
</tr>
<tr>
<td>7 Bronze Grass Skink</td>
<td>Eutropis macularia</td>
<td>Scincidae</td>
<td>NE</td>
<td>Image 9</td>
</tr>
<tr>
<td>8 Common Keeled Skink</td>
<td>Eutropis carinata</td>
<td>Scincidae</td>
<td>LC</td>
<td>Image 10</td>
</tr>
<tr>
<td>9 (Beddome’s) Cat Skink*</td>
<td>Ristella cf. beddomei</td>
<td>Scincidae</td>
<td>LC</td>
<td>Image 11</td>
</tr>
<tr>
<td>10 Oriental Garden Lizard</td>
<td>Calotes versicolor</td>
<td>Agamidae</td>
<td>NE</td>
<td>Image 12</td>
</tr>
<tr>
<td>11 Common Indian Krait</td>
<td>Bungarus caeruleus</td>
<td>Elapidae</td>
<td>NE</td>
<td></td>
</tr>
<tr>
<td>12 Beddome’s Cat Snake</td>
<td>Boiga beddomei</td>
<td>Colubridae</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>13 Common Wolf Snake</td>
<td>Lycodon aulicus</td>
<td>Colubridae</td>
<td>NE</td>
<td></td>
</tr>
<tr>
<td>14 Common Trinket Snake</td>
<td>Coelognathus helena</td>
<td>Colubridae</td>
<td>NE</td>
<td></td>
</tr>
<tr>
<td>15 (Common) Vine Snake</td>
<td>Ahaetulla cf. nasuta</td>
<td>Colubridae</td>
<td>NE</td>
<td>Image 14</td>
</tr>
<tr>
<td>16 Russell’s Kukri Snake</td>
<td>Oligodon taeniolatus</td>
<td>Colubridae</td>
<td>LC</td>
<td>Image 13</td>
</tr>
<tr>
<td>17 Checkered Keelback</td>
<td>Xenochrophis piscator</td>
<td>Natricidae</td>
<td>NE</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Species diversity and abundance of reptiles in selected agroecosystems in Thrissur District

<table>
<thead>
<tr>
<th>Species</th>
<th>Coconut Plantation</th>
<th>Cashew Plantation</th>
<th>Rubber Plantation</th>
<th>Home Garden</th>
<th>Botanical Gardens</th>
<th>Paddy Field</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hemidactylus cf. murrayi</td>
<td>47</td>
<td>20</td>
<td>7</td>
<td>10</td>
<td>0</td>
<td>82</td>
</tr>
<tr>
<td>2</td>
<td>Hemidactylus frenatus</td>
<td>40</td>
<td>6</td>
<td>16</td>
<td>3</td>
<td>0</td>
<td>69</td>
</tr>
<tr>
<td>4</td>
<td>Hemidactylus triedrus</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Cnemaspis spp.</td>
<td>10</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Cyrtodactylus collegalensis</td>
<td>7</td>
<td>6</td>
<td>15</td>
<td>2</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Sphenomorphus dussumieri</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
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<td>21</td>
<td>45</td>
<td>82</td>
<td>2</td>
<td>70</td>
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<td>Eutropis carinata</td>
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<td>9</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Ristella cf. beddomei</td>
<td>0</td>
<td>11</td>
<td>5</td>
<td>0</td>
<td>28</td>
<td>0</td>
</tr>
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<td>11</td>
<td>Calotes versicolor</td>
<td>16</td>
<td>11</td>
<td>9</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>12</td>
<td>Bungarus caeruleus</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Boiga beddomei</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Lycodon aulicus</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
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<td>15</td>
<td>Coelognathus helena</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Ahaetulla cf. nasuta</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Oligodon taeniolatus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Xenochrophis piscator</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
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<td>Total</td>
<td>145</td>
<td>112</td>
<td>143</td>
<td>30</td>
<td>159</td>
<td>5</td>
<td>594</td>
</tr>
</tbody>
</table>
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and environmental variables are depicted in the CCA triplot (Fig. 3). The first two CCA axes were significant (permutations 999, trace = 1.047, P = 0.001; canonical axis 1, eigenvalue = 0.4199, P = 0.001; canonical axis 2, eigenvalue = 0.2819, P = 0.001) and together they explained 67% total inertia in the data. Both species composition and environmental parameters of the different plantation types were different with no overlap for paddy fields, indicating that paddy fields are not only distinctly different in the environmental parameters but has a different reptile fauna. *Xenochrophis piscator* was unique to the paddy field habitat while *Lycodon aulicus* was more abundant in the paddy field as compared to other habitats and both these factors...
could be correlated to the relatively higher humidity and temperature of paddy field habitats and lower canopy cover, canopy height, litter depth, litter cover, shrub cover, and herb cover (Fig. 3). In general, species such as *Boiga beddomei*, *Bungarus caeruleus*, *Calotes versicolor*, *Coelagnathus helena*, *Hemidactylus frenatus*, *H. cf. murrayi*, *H. triedrus*, *Sphenomorphus dussumieri*, *Lycomdon alicius*, and *Xenochrophis piscator* preferred relatively higher humidity and temperature and lower canopy cover, canopy height, litter depth, litter cover, shrub cover, and herb cover. As a result, these species mainly favoured home gardens and paddy fields in Kole Wetlands, followed by cashew and coconut plantations and, rarely, rubber plantations or botanical gardens. On the other hand, *Ahaetulla cf. nasuta*, *Cnemaspis* sp., *Cryodactylus collegalesis*, *Eutropis macularia*, *Eutropis carinata*, *Oligodon taeniatus*, and *Ristella cf. beddomeii* preferred higher canopy cover, canopy height, litter depth, litter cover, shrub cover, and herb cover and favoured rubber plantations and botanical gardens, followed by cashew and coconut plantations (Fig. 3).

While this is a preliminary, pooled analysis consisting of resource use frequencies of both active and dormant sightings, it gives at least a preliminary picture of probable impacts on resultant species records. We mention this with a caution that more studies with better sample size and discerning active and dormant sightings are needed to fully understand the impacts of these abiotic variables on species composition and assemblage structure. We believe that our work will pave the way for future studies to take a deeper look into this subject (also see Vijayakumar et al. 2006).

Palacios et al. (2013), who reviewed studies on the herpetofauna in human-modified habitats across the world, found that in 81% of the cases plantations supported more herpetofauna than natural forests. They also found that human-modified habitats support even some endemic species in agroecosystems. Two species of reptiles endemic to the Western Ghats, *Ristella cf. beddomeii* and *Sphenomorphus dussumieri*, were recorded from the agroecosystems of central Kerala. The present sighting of the *Ristella cf. beddomeii* from the agroecosystem at an elevation of 50m is lower than the known altitude range of 400–1300 m (Srinivasulu et al. 2014) of this species.

Apart from addressing reptile conservation in managed landscapes, our study also fills in a major gap in herpetological studies in southern India – their community assemblage structure. Very few studies have elaborated on this topic. Studies from Western Ghats rainforests (Inger et al. 1987), the Western Ghats dry forests (Vijayakumar et al. 2006), Eastern Ghats wet forests (Ganesh & Arumugam 2015; & Ramesh & Arumugam 2016), and the Coromandel coastal plains scrub forests (Ramesh et al. 2013) are available. The current paper provides a first-hand data on reptile assemblage structure from a central Kerala plains site, that too from the little-studied Palghat Gap region.

This documentation is important as it highlights the significance of agroecosystems in conserving and maintaining the reptilian fauna of the region, including some of the Western Ghats endemic species.

REFERENCES


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Image 1. Hemidactylus cf. murrayi

Image 2. Hemidactylus frenatus

Image 3. Hemidactylus frenatus (in rubber plantation)

Image 4. Hemidactylus triedrus

Image 5. Cnemaspis cf. gracilis (female) from homegarden

Image 6. Cnemaspis cf. gracilis (male) from botanical garden
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Image 7. *Cyrtodactylus collegalensis*

Image 8. *Sphenomorphus dussumieri*

Image 9. *Eutropis macularia*

Image 10. *Eutropis carinata*

Image 11. *Ristella cf. beddomii*

Image 12. *Calotes versicolor*


Communications

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