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Herpetofaunal Diversity in Chitradurga District, Karnataka: A Semi-Arid Landscape in Southern India

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ABSTRACT

Herpetofauna, both amphibians and reptiles have been dealt with at length by biodiversity studies as part of studying animal groups. Among all animal groups, herpetofauna is a flagship group in both the terrestrial and aquatic ecosystems and play an important role in the food chain. In this context, a study was conducted in the semi-arid Chitradurga district located in the state of Karnataka, India. This semi-arid region experience high temperatures with moderate annual rainfall. The semi-arid environment plays a major role in the distribution and diversification of taxa. The present study was aimed at compiling an inventory and the diversity status of the herpetofauna of Chitradurga district to understand the structure and composition of herpetofaunal communities. Data collection was carried out from August 2014 to July 2016. Standard ecological method i.e. Visual Encounter Survey (VES) was adopted for enumerating the Herpetofaunal species. We documented 29 herpetofaunal species belonging to nine families. Among these species, six were amphibians and 23 were reptiles. Among amphibians and reptiles Dicroglossidae and Gekkonidae were the most dominant families. Amphibian diversity was more during and after rainy seasons, whereas reptiles diversity was more during summer and rainy seasons. Most of the herpatiles were observed in and around agricultural and barren habitats. The region was subjected to enormous pressure on natural resources due to human activities. As Chitradurga district is located in the heart of Deccan plateau under a semi-arid region of the country, this could be one of the promising regions for undertaking detailed herpetological studies.

Key words: Amphibians, Reptiles, Semi-arid Environment, Biodiversity, Deccan plateau

INTRODUCTION

India is a vast and diverse country with high geographical and ecosystem complexity and different kinds of natural formations (Alfred et al. 2001), and is home to a large number of diverse flora and fauna. However, current global changes such as land-use practices, high pressure on natural resources, climate change and pollution are increasingly putting at risk both biodiversity assemblages and human societies directly and indirectly (Díaz et al. 2006, Ceballos et al. 2015, Roth-Monzón et al. 2018). Nevertheless, many determined efforts have been made to document and conserve biodiversity, and design policy framings, but still, there is a need for continuing such type of efforts very effectively (Purvis and Hector 2000). Composition and diversity of species in dry lands are entirely different from temperate and tropical environmental regions (Cruz-Elizalde et al. 2016). Tropical and temperate environments show the number of species richness and diversity, because of the diversified food availability, habitat types and climatic conditions (Wiens et al. 2006, Cortés et al. 2008). Dry lands, such as arid regions, semi-arid regions and deserts also display some amount of species richness and are home to some of the most threatened species, and also for some endemic species (Flores-Villela and Gerez 1994, Bastin et al. 2017). The survival of any organism in the arid environment is very challenging and difficult. Owing to this condition, their life may be unstable, but they are incredibly

resilient to arid environments (Holing 2001). Most of the literature related to biodiversity conservation policies were focused on tropical and temperate forest areas and biodiversity hot spots. However, dry lands have been less studied and highly neglected concerning biodiversity-related issues (Myers et al. 2000, Schimel 2010, Durant et al. 2012, Nautiyal et al. 2015, Bastin et al. 2017). Biodiversity of any ecosystem provides essential economic, socio-cultural and ecological resources that serve as the sustainability basis of any region; thus it pays significant attention to the quality of human life with a generally positive impact on the region or ecosystem (Semwal et al. 2004, Nautiyal and Kaechele 2007, Nautiyal 2011). Hence, it is important to study the biodiversity of such drylands, mainly in the context of their recent decline due to degradation of their natural habitats (Velázquez and Palacio-Prieto 2010).

Among biodiversity studies concerning animal groups, flagship groups such as amphibians and reptiles have become the main focus of many current biodiversity studies, because of a high percentage of threatened species with most of the species falling under data deficient status of IUCN categories (Gardner et al. 2007a). Herpetofaunal association with humanbeings is very high in day-to-day life in different aspects (Alves et al. 2012, 2013, Mendonça et al. 2014). Apart from this, herpetofauna populations are also declining very rapidly on a global scale due to various factors; i.e. social pressure and human activity on natural resources, land cover changes and climate change (Gibbons et al. 2000, Velázquez and Palacio-Prieto 2010, Roth-Monzón et al. 2018). Apart from these reasons, herpatiles, mainly reptiles, are closely associated with arid environments and niches (Pie et al. 2017). Moreover, studying about Herpetofauna in any ecosystem is a challenging task due to various biological and physical activities such as hibernation, camouflage,

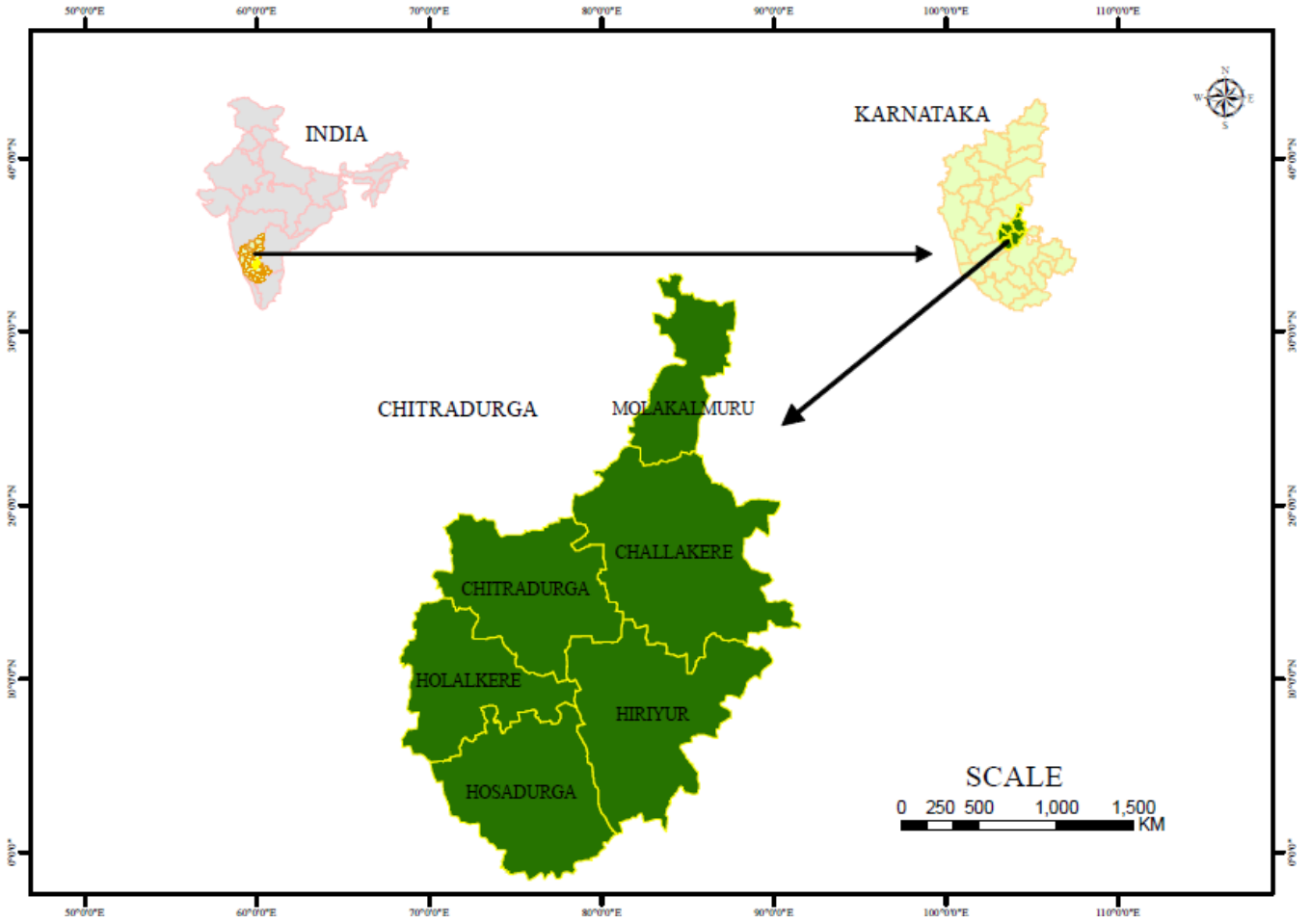

Figure 1. Location map of the study area in semiarid Chitradurga District

cryptic nature and climatic factors affecting herpetofaunal species (Conant and Collins 1998). Moreover, the studies on Herpetofauna are mostly confined to only some restricted and protected areas (Ramesh 2013). Therefore, this study was undertaken for documenting and studying the status of herpetofauna in the semi-arid region of Chitradurga district of Karnataka state, India. The present study on herpetofauna was intended to support conservation policies and management strategies for this region and other similar semi-arid regions of India and the world.

MATERIAL AND METHODS

Study area

The present study was undertaken in Chitradurga district, which is located in the heart of Deccan plateau and a central part of the Karnataka state of India with a semi-arid climate, covering an area of 8436Km^2. This district comprises six regions as Chitradurga, Challakere, Hiriyur, Hosadurga, Holalkere, and Molakalamuru and the district falls between latitude 13º 34' to 15º 02' N and longitude 76º 01' to 77º 01' E with elevation of 732 meters above MSL (Fig. 1) (Government of India 2014). This district experiences low to moderate rainfall (average rainfall is 744 mm), hot summer and pleasant monsoon. This district has seasonally dry and tropical savannah climate. Summer starts in early March and extends up to the first week of June. April is the hottest month with the average temperature of 41^{0}C. Monsoon season starts from June and it will extend up to November. Pleasant weather could be found due to Southwest monsoon in the early June and extend to September and Northeast monsoon from October to November. Winter sets at the end of November and it extends up to end of the February. December is the coldest month with the average minimum temperature (16.6^{0}C). Maximum and minimum temperature of Chitradurga district is 37 and 15°C respectively (Babu 2013). The main physical features of this area include mostly xerophytes, vegetation cover composed mainly of shrubs, herbs, grasses and a few tree species. The forested area of this district is classified under two sub-groups, namely, southern tropical thorn forests and southern tropical dry deciduous forest (Champion and Seth 1968). The main landscape features of this district include built-up land, agricultural land, thorny, dry deciduous forest tracts, grasslands and a few wetlands (Thippaiah 2010).

Methodology

The herpatiles monthly survey was carried out from August 2014 to July 2016 across different aquatic, human settlements, agricultural and forest habitats. The survey was conducted for six days a month with a total of 6 hours spent per day (morning: 07.00 - 09.00; afternoon: 13.00 -15.00 and evening: 19.00 to 20.00) when herpatiles are active. Standard ecological method, Visual Encounter Survey (VES) method was adopted for recording (presence or absence) and to record the abundance of herpetofauna (Crump and Scott 1994, Sutherland 2006). During the survey, all possible potential habitats of both amphibians and reptiles were searched through random walks within a pre-defined time frame; photographs of herpatiles were taken for identification of species. Field guides and taxonomic literature (Daniel 2002, Daniels 2005, Whitaker and Captain 2004) used for the identification of herpetofaunal species. During survey period habitat types of individual herpetofauna species were also observed and noted. Besides, local threats to the herpatiles were also recorded during our survey period.

Quantitative analysis

Relative abundance (Singh and Rai 2000), frequency and species distribution ratio (Cottam and Curtis 1956; Rajashekara and Venkatesha 2014) were calculated by using the following formulae:

· Relative Abundance $(A) = a/NX100$

a = Total population of a particular species and N = Total population of all species.

· Frequency $(F) = mX100/M$

m = occurrence of species in given samples, M = Total number of samples

· Species Distribution Ratio= Abundance / Frequency

· Shannon-Weiner's diversity H' = " Pi ln Pi

Where Pi is the proportion of total individuals belong to the i th species in the sample (Shannon and Wiener 1949)

· Fisher's alpha diversity = $S = a* \ln (1+ n/a)$,

Where *S* = is the number of taxa, *n* = is the number of individuals and *a* = is Fisher's alpha (Fisher et al. 1943)

· Margalef's species richness R1 = (S-1) / ln N,

Where S = is the number of species in a community and N = is the total number of individuals observed in that particular community. (Margalef 1958)

· Evenness index E2 = *eH / S* ; (0 < E < 1),

Where, e = is the natural logarithm base, H' = Shannon-Wiener's diversity index and S = Number of species (Sheldon 1969).

The Shannon-Weiner's diversity, Fisher's alpha diversity, Margalef's species richness and Evenness indices of Herpetofauna populations were estimated using the above formula. Differences in diversity between two years were assessed by student t-test utilizing PAST software version 3.22 (Hammer et al. 2001).

RESULTS

A total of 29 species belonging to 24 genera and 12 families of herpetofauna were recorded from the study area. Among them, 23 species of reptiles were belonging to 24 genera from nine families, and six amphibian species belonging to three families (Table 1). The amphibian family Dicroglossidae was the most dominant and diverse family in the study region; however, Bufonidae and Rhacophoridae families also showed a similar diversity and distribution patterns (Fig. 2). Among nine families of reptiles Gekkonidae was the most dominant and diverse family, followed by Colubridae and Agamidae, whereas, Boidae, Chamaeleonidae, Viperidae and Varanidae showed a less diversity and distribution patterns (Fig. 2).

A total of six amphibian species were recorded during the study period. Among them, relative abundance and frequency of *Euphlyctis cyanophlyctis* was more followed by *Hoplobatrachus tigerinus* and *Duttaphrynus melanostictus*. However, *Polypedates maculatus* showed less diversity and distribution pattern for the year 2014-15. Similar types of diversity and distribution pattern of amphibians have been observed for 2015-16 in the study regions (Table 2).

Among the recorded 23 species of reptiles, *Psammophilus dorsalis* was the most abundant species followed by *Hemidactylus vijayraghavani,*

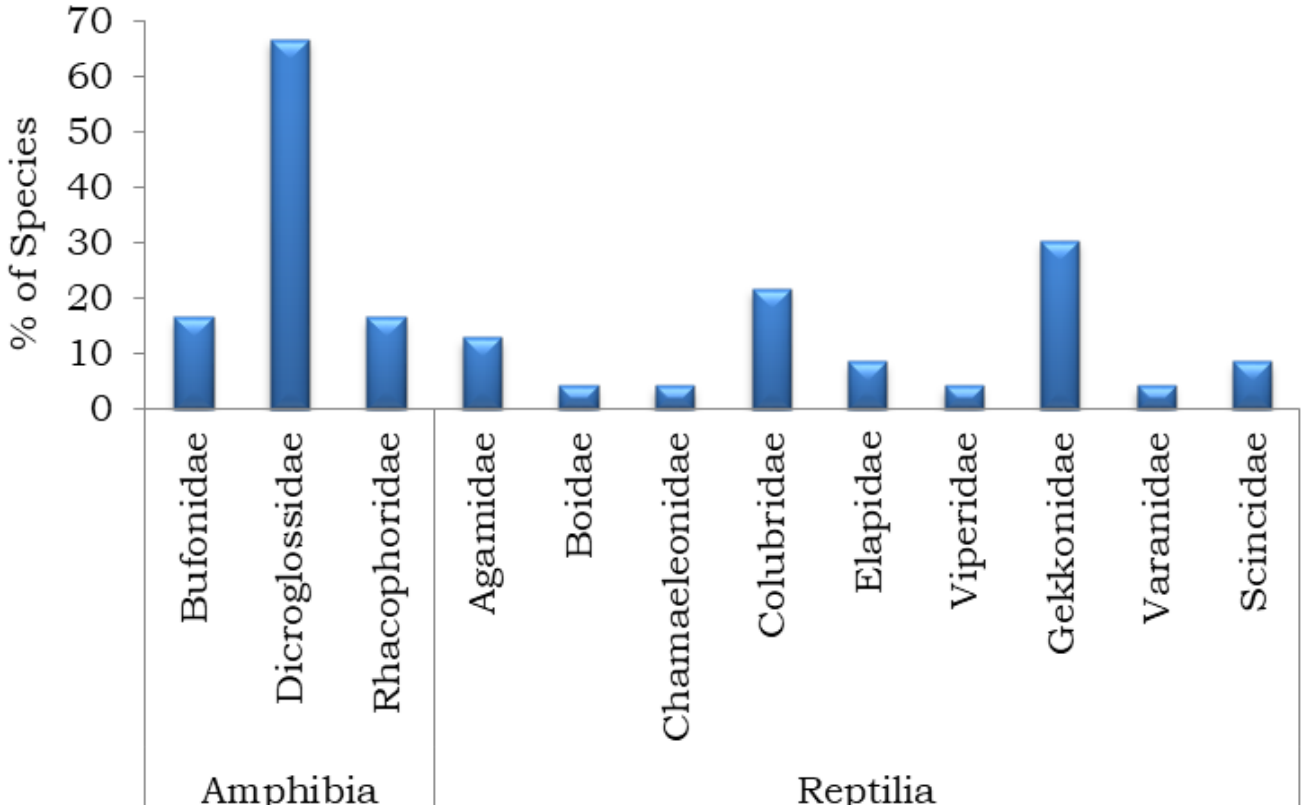

Figure 2. Species (%) of amphibians and reptiles under different families at semiarid region of Chitradurga district during 2014-16

Table 1. Checklist of herpetofaunal species of semiarid Chitradurga district during 2014-16.

Family	Scientific name	Common name	IWPA*	IUCN&	Habitat type#
Amphibians					
Bufonidae	*Duttaphrynus melanostictus* Schneider, 1799	Common Indian Toad	Sch-IV	LC	Low land areas, Human dominated areas and agriculture lands
Dicroglossidae	*Hoplobatrachus tigerinus* Daudin, 1803	Indian Bull Frog	-	LC	Aquatic, Freshwater wetlands
Rhacophoridae	*Polypedates maculatus* J.E.Gray 1830	Common Indian Tree Frog	Sch-IV	LC	Leaf Litter, Trees, shrubs and human settlements
Dicroglossidae	*Euphlyctis cyanophlyctis* Schneider, 1799	Skittering Frog	Sch-IV	LC	Aquatic, over the water surface and corner of pond vegetation
Dicroglossidae	*Minervarya keralensis* Dubois, 1981	Cricket Frog	-	LC	Grassland and Aquatic
Dicroglossidae	*Sphaerotheca breviceps* Schneider, 1799	Burrowing Frog	-	LC	Wetland, Grassland, and Shrubland
Reptiles					
Agamidae	*Calotes versicolor* Daudin, 1802	Indian garden lizard	Sch-IV	LC	Agriculture land
Agamidae	*Sarada deccanensis* Jerdon, 1870	Fan throat lizard	-	LC	Agriculture and forest lands
Agamidae	*Psammophilus dorsalis* Gray, 1831	Peninsular rock agama	-	LC	Rocky area and Agriculture
Boidae	*Eryx johnii* Russell, 1801	Sand boa	-	NT	Hilly area (Foothills), Scrubby land
Chamaeleonidae	*Chamaeleo zeylanicus* Laurenti, 1768	Chamelion	-	LC	Shrubland, Barren lands and Agriculture
Colubridae	*Lycodon aulicus* Linnaeus, 1758	Common wolf snake	Sch-IV	LC	Rocky, Shrubland, Barren land, Agriculture and Human dominated
Colubridae	*Ptyas mucosa* Linnaeus, 1758	Ratsnake	Sch-II	LC	Agriculturelands,Shrubby, and Human settlements
Colubridae	*Oligodon taeniolatus* Jerdon, 1853	Veriegated kukri snake	Sch-IV	LC	Agriculture, Rocky, Shrubby and Barren land
Colubridae	*Ahaetulla nasuta* Lacépède, 1789	Green vine snake	Sch-IV	LC	Agriculture, Human settlements, Hilly and Shrubby
Elapidae	*Naja naja* Linnaeus, 1758	Common cobra	Sch-II	LC	Agriculture, Human settlements, Hilly areas, Grasslands, Barren lands and Shrubby
Elapidae	*Bungarus caeruleus* Schneider, 1801	Common Krait	Sch-IV	LC	Human dwellings, Agriculture, Rocky, Shrubby, Barren lands Mostly prefers wet areas
Viperidae	*Daboia russelii* Shaw&Nodder, 1797	Viper	-	LC	Grasslands, Shrub lands and Agriculture
Colubridae	*Coelognathus helenus* Daudin, 1803	Trinket snake	-	LC	Shrubby lands, Foothills, Human settlements
Gekkonidae	*Hemidactylus frenatus* Schlegel, 1836	Common house gecko	Sch-IV	LC	Human dwellings
Gekkonidae	*H. parvimaculatus* Deraniyagala, 1953	Spotted house gecko	Sch-IV	LC	Human habitats, woodland, forest
Gekkonidae	*H. maculatus* Duméril & Bibron, 1836	Rock gecko	-	LC	Rocky area
Gekkonidae	*H. leschenaultii* A.M.C. Duméril & Bibron, 1836	Barc gecko	-	LC	Human habitations, woodlands, Agriculture lands, Shrubby lands
Gekkonidae	*H. reticulatus* Beddome, 1870	Reticulated ground gecko	-	LC	Open areas, Barren lands, Human habitats, Scrubland, Agriculture
Gekkonidae	*Hemidactylus Vijayraghavani* Mirza 2018	Termite-hill gecko	-	LC	Barren lands, Open lands, Scrubland, Human habitats, Agriculture
Gekkonidae	*Hemiphyllodactylus aurantiacus* Beddome, 1870	Southern worm gecko	-	LC	Barren lands
Varanidae	*Varanus bengalensis* Daudin, 1802	Common Indian monitor lizard	Sch-I	LC	Forest, Agriculture, Scrubland, Water bodies and Grasslands
Scincidae	*Eutropis carinata* Schneider, 1801	Common grass skink	Sch-IV	LC	Scrubland, Grassland, Forest, Human habitats, Agriculture
Scincidae	*Riopa punctate* Gmelin, 1799	Common snake skink	Sch-IV	LC	Grasslands, Scrublands, Agriculture lands

LC- Least concern; NT- NearThreatned; Sch – Schedule.

*IWPA (Indian Wildlife Protection Act) http://nbaindia.org/uploaded/Biodiversityindia/Legal 15.%20Wildlife%20(Protection)%20Act, %201972.pdf

&IUCN(International Union for Conservation of Nature).https://www.iucnredlist.org/(The IUCN Red list of Threatened Species)

#Field observations

Table 2. Relative abundance, percent frequency and species distribution ratio of amphibians of semiarid Chitradurga district during 2014-16.

Species	2014-2015			2015-2016		
	Relative Abundance	Frequency	Species distribution Ratio	Relative Abundance	Frequency	Species distribution Ratio
Duttaphrynus melanostictus	19.94	22.57	0.88	22.08	22.57	0.98
Hoplobatrachus tigerinus	23.31	18.75	1.24	19.23	17.01	1.13
Polypedates maculatus	7.72	11.46	0.67	11.84	13.19	0.90
Euphlyctis cyanophlyctis	26.47	22.57	1.17	20.32	19.44	1.04
Minervarya keralensis	10.96	19.44	0.56	13.69	21.18	0.65
Sphaerotheca breviceps	11.59	19.10	0.61	12.85	17.71	0.73

Table 3. Relative abundance, percent frequency and species distribution ratio of reptiles of semiarid Chitradurga district during 2014-16.

Species	2014-2015			2015-2016		
	Relative Abundance	Frequency	Species distribution Ratio	Relative Abundance	Frequency	Species distribution Ratio
Calotes versicolor	6.74	32.29	0.21	6.61	29.86	0.22
Sarada deccanensis	5.09	25.35	0.20	4.04	22.57	0.18
Psammophilus dorsalis	8.50	27.43	0.31	8.59	31.25	0.28
Eryx johnii	1.60	9.03	0.18	1.34	9.38	0.14
Chamaeleo zeylanicus	2.87	16.67	0.17	3.03	20.83	0.15
Lycodon aulicus	3.76	20.83	0.18	2.81	19.44	0.14
Ptyas mucosa	4.68	25.35	0.18	4.47	25.35	0.18
Oligodon taeniolatus	3.26	19.10	0.17	2.52	15.28	0.16
Ahaetulla nasuta	2.85	20.14	0.14	3.56	20.49	0.17
Naja naja	4.04	22.92	0.18	4.02	21.88	0.18
Bungarus caeruleus	3.82	21.18	0.18	3.88	21.88	0.18
Daboia russelii	3.59	17.36	0.21	4.52	20.49	0.22
Coelognathus helenus	1.35	6.94	0.19	1.63	6.25	0.26
Hemidactylus frenatus	6.23	26.04	0.24	6.88	24.31	0.28
H. parvimaculatus	3.89	17.36	0.22	5.01	19.44	0.26
H. maculatus	5.37	19.44	0.28	5.78	21.53	0.27
H. leschenaultii	5.83	25.69	0.23	5.92	26.74	0.22
H. reticulatus	4.96	23.61	0.21	5.46	22.92	0.24
H. vijayraghavani	7.40	23.61	0.31	5.06	21.53	0.24
H. aurantiacus	5.09	20.49	0.25	6.00	24.65	0.24
Varanus bengalensis	3.38	17.71	0.19	2.73	17.71	0.15
Eutropis carinata	2.87	16.67	0.17	2.49	14.93	0.17
Riopa punctate	2.82	16.67	0.17	3.64	20.83	0.17

Calotes versicolor and *Hemidactylus frenatus*. However, *Calotes versicolor* percent frequency was higher than other species in the study region (Table 3).

Monthly diversity and evenness indices for amphibian species of Chitradurga district are presented in Table 4. For the year 2014-15 diversity ($H^{'}$) values ranged from 1.43 to 1.68, whereas evenness values (E_1) ranged between from 0.70 to 0.90. Similarly, for the year, 2015-16 diversity values ranged from 1.62 to 1.72, whereas evenness values ranged between from 0.84 to 0.93. There was no significant difference ($P > 0.05$) in diversity as well as in evenness of amphibian fauna between the years studied during 2014-16 (Table 4). For the year 2014-15, the richness of amphibian species was found more during the monsoon season (July to November) (Table 4). Amphibians show more diversity during and after the rainy season and less diversity during summer (March to June) (Fig. 3).

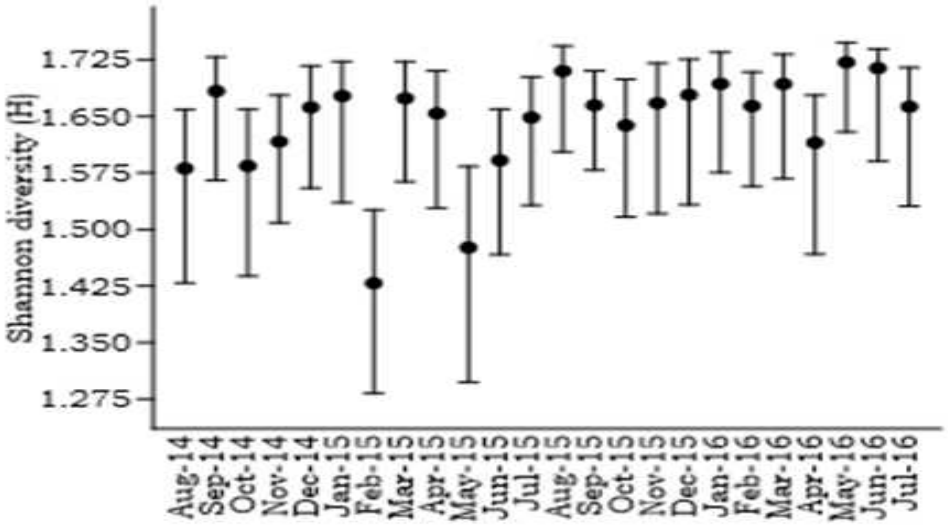

Figure 3. Monthly Shannon diversity (H) index of amphibians of semiarid Chithradurga district during 2014-16

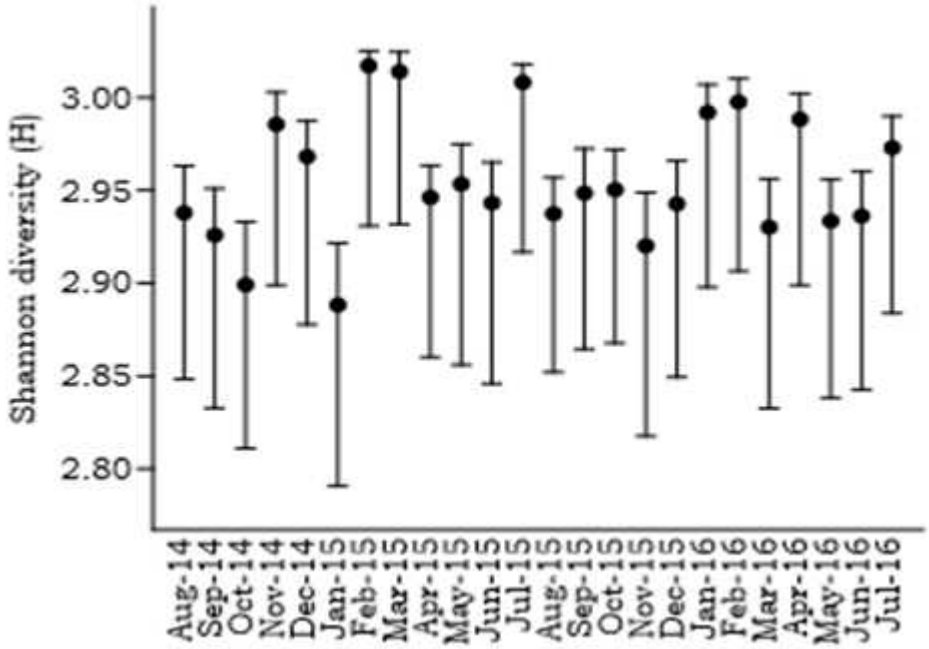

Figure 4. Monthly Shannon diversity (H) index of reptiles of semiarid Chitradurga district during 2014-16.

Monthly diversity and evenness indices for reptiles of Chitradurga district are presented in Table 5. For the year 2014-15 diversity (H^1) values ranged from 2.89 to 3.02, whereas evenness values (E_1) ranged between from 0.78 to 0.89. Similarly, for the year, 2015-16 diversity values ranged from 2.92 to 3.00, whereas evenness values ranged between from 0.81 to 0.87. There was no significant difference ($P > 0.05$) in diversity as well as in evenness of reptilian fauna during 2014-16 (Table 5). During 2014-15, the richness of reptilian species was found more during summer (March to June) and rainy seasons (June to November), whereas, the richness of reptilian species was found less during the winter season (November to February (Fig. 4).

DISCUSSION

India is a home for about 432 amphibian species (Dinesh et al. 2019) and 572 reptiles, which include

Table 4. Diversity, evenness and richness of amphibians of semiarid Chitradurga district during 2014-16

Month	Diversity indices							
	Shannon-Weiner's diversity (H^1)		Margalef's species richness		Fisher's alpha diversity		Evenness index (E_1)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
August	1.58	1.71	1.09	1.07	1.41	1.37	0.81	0.92
September	1.68	1.67	1.07	0.96	1.37	1.18	0.90	0.88
October	1.58	1.64	1.07	1.04	1.38	1.33	0.81	0.86
November	1.62	1.67	0.99	1.13	1.24	1.48	0.84	0.88
December	1.66	1.68	0.99	1.14	1.24	1.50	0.88	0.89
January	1.68	1.69	1.15	1.08	1.52	1.39	0.89	0.91
February	1.43	1.66	1.01	1.13	1.26	1.49	0.70	0.88
March	1.67	1.69	1.05	1.12	1.34	1.46	0.89	0.91
April	1.65	1.62	1.06	1.22	1.36	1.65	0.87	0.84
May	1.48	1.72	1.10	1.07	1.43	1.37	0.73	0.93
June	1.59	1.71	1.01	1.16	1.27	1.54	0.82	0.93
July	1.65	1.66	1.05	1.10	1.35	1.42	0.87	0.88

Table 5. Diversity, evenness and richness of reptiles of semiarid Chitradurga district during 2014-16

Month	Diversity indices							
	Shannon-Weiner's diversity (H^1)		Margalef's species richness		Fisher's alpha diversity		Evenness index (E_1)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
August	2.94	2.94	3.73	3.59	5.46	5.21	0.82	0.86
September	2.93	2.95	3.81	3.71	5.68	5.39	0.81	0.83
October	2.90	2.95	3.72	3.75	5.42	5.50	0.79	0.83
November	2.99	2.92	3.76	3.84	5.54	5.75	0.86	0.81
December	2.97	2.94	3.80	3.82	5.63	5.69	0.85	0.82
January	2.89	2.99	3.74	3.83	5.48	5.73	0.78	0.87
February	3.02	3.00	3.84	3.82	5.75	5.71	0.89	0.87
March	3.01	2.93	3.77	3.95	5.57	6.08	0.89	0.81
April	2.95	2.99	3.61	3.84	5.28	5.75	0.87	0.86
May	2.95	2.93	3.91	3.91	5.95	5.94	0.83	0.82
June	2.94	2.94	3.90	4.00	5.94	6.21	0.83	0.82
July	3.01	2.97	3.86	3.85	5.82	5.78	0.88	0.85

crocodiles, lizards, snakes turtles and tortoises (Aengals et al. 2018). Several researchers contributed to Indian herpetological studies (Günther 1864, Smith 1931, Smith 1935, Tikedar 1992, Das 1996, 2003, Das and Dutta 1998, Dutta 1997, Daniel 2002, Daniels 2005, Murthy 2010, Dinesh et al. 2013, 2017). Concerning Karnataka state, many researchers contributed to the Herpetofauna studies (Rao 1920, 1922, 1937, Daniels 1991, Biju 2001, Dilhan et al. 2004, Ravichandran and Krishnan 2006, Ramachandra et al. 2012, Srinivsaulu 2014). Except for few studies on dry land herpetofauna (Nautiyal 2013, Nautiyal 2015, Jadesh et al. 2014), most of the studies were carried out in the Western Ghats and other high dense vegetation regions of Karnataka (Nautiyal et al. 2018).

Amphibian, *Duttaphrynus melanostictus* was frequently found in different habitats and even in human-dominated areas due to its cosmopolitan nature (Dutta 1997). Every species diversity and abundance always varies from place to place, and it depends on the structure of habitats, rainfall, temperature and availability of food and disturbance levels (Daniels 1992). Similarly, most of the amphibians were observed near aquatic ecosystems and in leaf litter. Leaf litter will provide shelter for

many organisms, and they coexist in leaf litter (Nath et al. 2012). Since the study area is the semi-arid region with less rainfall and severe water scarcity, the populations of amphibians were less. We observed some amphibian species in everywhere ponds, marshes and reservoirs of the region,. As this region falls under the rain shadow area, most of the farmers have constructed farm ponds for storing water for agricultural activities. These structures were supporting the breeding of amphibians and thereby helpful for their survival.

Among the herpetofaunal species, *Calotes versicolor* was frequently found in the region. Most of the reptile diversity was more during summer and monsoon seasons when compared to winter as recorded by Nautiyal et al. (2015). Most of the species were observed near agricultural lands. Among snakes *Naja naja* abundance was found more followed by *Ptyas mucosa* as they found in most of the habitats i.e. near human settlements, as well as in agriculture and scrub forests as reported by Daniel (2002) and Nath et al. (2011). During study period, we observed the conflict between human and non-venomous snakes (*Ptayas mucosa, Oligodon taeniolatus*, *Coelognathus helenus*), and they were killed because people were not aware of non-venomous nature of these snakes. Nath et al. (2011) reported similar observations.

Among six amphibian species, three species, i.e., *Duttaphrynus melanostictus, Polypedates maculatus*, *Euphlyctis cyanophlyctis* are listed under Schedule –IV of Indian wildlife protection act - 1972 (IWPA) and among 23 reptiles, one species was listed under Schedule-I, two species under schedule –II and nine species under Schedule – IV of IWPA. Among 29 herpetofauna species, only one species (*Eryx johnii)* listed under the near-threatened status of IUCN red list data book. From the conservation point of view, one species *Varanus bengalensis* from the study area falls under Schedule –I of IWPA act and the diversity of this species was also low when compared to other reptilian species. It was found that *V. bengalensis* adults were killed for extracting oil. Some people believe that the oil of this species has medicinal properties to cure joint and muscular pains. *V. bengalensis* were threatened by various human activities (hunting and poaching), and they need special conservational management (Hasmi et al. 2013).

Climate (monsoons) driven environment might play a major role in diversification patterns among the broadly distributed taxa. This can be observed in the evolutionary process of the taxa. A study from Indian subcontinent claims that, Fan throated lizards (Genus: *Sarada* and *Sitana*) species are widely distributed and restricted to the semi-arid zones of the country (Deepak and Karanth 2018). Similar observations were also made during the survey period from the study region, as this present study was undertaken in one of the semi-arid regions of the country which is located in the Karnataka state. With this, it can be concluded that the recorded Herpeto faunal species from the study region could be a considered as indicator species of the semi-arid environments. The herpetofauna was always threatened due to various environmental and anthropogenic activities (Joshi et al. 2015, 2017). During our study period, many potential threats to herpetofauna i.e. habitat destruction due to various developmental activities, usage of chemicals and pesticides in agricultural activities and road accidents were observed. These apart, lack of knowledge on the part of people about snakes and other reptiles and their role in maintaining ecological balance was also leading to the loss of herpetofaunal species in the semi-arid region.

Every individual herpetofaunal species was closely associated with their habitats and they play a crucial role in ecosystem functioning (Connelly 2019). If any disturbance occurs in their habitat, the entire food cycle of the ecosystem will get disturbed. Keeping this in view, we suggest considering our study results as a baseline data for further studies on microhabitat linkage of every individual herpetofaunal species to design appropriate policy measures for conservation of rich herpetofaunal biodiversity of semi-arid Chitradurga region.

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