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NILGIRI SALEA (*SALEA HORSFIELDII*) IN URBAN AREAS OF UDHAGAMANDALAM, THE NILGIRIS, TAMIL NADU

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ABSTRACT

The study was carried out from January to December 2017 in urban areas of Udhagamandalam, The Nilgiris, Tamil Nadu, India. The visual Encounter Surveys (VES) method was applied for searching of Nilgiri salea (*Salea horsfieldii*). During the study period, 110 individuals of *Salea horsfieldii* were observed in 60 days survey and 300 man-hours. The *Salea horsfieldii* varied from 0 to 8 with a mean of 1.83 ± 1.75. The encounter rate was 0.36 lizards per hour. Among these, 53 (57 %) individuals were males and 44 (43 %) individuals were females. This result shows that a male-biased sex ratio was found in species 1.2: 1 (Male: female). Size class data show that most of the individuals were adults 71 (65 %). The adult lizards, a total of 45 (63%) individuals of males, and 26 (37%) individuals were females. In sub-adults (n=26), a total of 8 (31%) individuals of them were males and 18 (69 %) individuals were females. A total of 13(12%) individuals of the juvenile were recorded.

Key Words: Adult, Nilgiris, *Salea horsfieldii*, Tamil Nadu, Urban area

INTRODUCTION

Urbanization is increasing rapidly worldwide in both spatial extent and density. Nearly two-thirds of the world's terrestrial area now support human populations, and associated land-use changes have destroyed natural areas, along with the creation of new habitats composed of human structures, impervious surfaces, nonnative and managed vegetation, unstable microclimates, and isolated natural remnants (McKinney 2002). Many species cannot withstand such dramatic changes to their environments; however, other species persist and even thrive in urban habitats. This leads to patterns of reduced species diversity but the increased abundance of urban-tolerant species (Shochat *et al* 2006). The vital functions of animal population and ecology deal with the population dynamics, utilization of their microhabitats, and behavioral patterns. When animals commence their daily activities such as basking, foraging, and searching for mates, then they may be inhibited to engage in the activities for certain periods of the day (Schoener 1977). Most reptiles display

high activity during the times of the day and the factors monitoring the periodicity interactions in a complex manner (Heatwole and Taylor 1987). Biological diversity can be improved by increasing the habitat size, reducing habitat fragmentation, and increasing the habitat quality by enhancing its structural diversity. Among the known 3000 lizard species in the world, about 270 species are found in the Indian subcontinent and also, in the Oriental biogeographic realm along with Southeast Asia (Wallace 1876, Mani 1974). Among the various group of Reptilia, the order Squamata exhibited a distinctly different biogeographical pattern, and Squamates (a diverse group of legged animals - lizards and legless animals - snakes) were found mostly on the land masses of Gondwanan origin (Macey *et al* 2000). Depending upon the habitat, prey availability, and thermal ecology, the lizard communities complete themselves utilizing resource partitioning by spatial or temporal separation with their regular and daily activities (Heatwole and Taylor 1987). Urban areas including Indian cities such as Ahmednagar, Bengaluru, Chennai, Delhi, Kolkata, Mumbai, Guwahati, etc. illustrate the high biodiversity of several taxa (Purkayastha *et al* 2011). Even though urbanization is detrimental to biodiversity, cities can be a hotspot for animal monitoring, assessment, and conservation (Aronson *et al* 2014). While historical monuments such as forts, palaces and their premises, and archaeological sites, towers, temples, and their habitats lodges >20% of the total urban area, such areas may dock up to half the biodiversity of the urban biota in different locations of India. *Salea horsfieldii* is an endemic lizard the distribution is only restricted to the Nilgiris mountains. Very few kinds of literature are available on this species on distribution and sexual characteristics (Caleb Daniel *et al* 2017). The present study aimed to attempt the presence of *Salea horsfieldii* in urban areas of Udhagamandalam areas of the Nilgiris, Tamil Nadu India.

SPECIES INTRODUCTION

Salea horsfieldii (subfamily: Draconinae) is a high-elevation agamid, which exhibits ornamentation in both juvenile and adult stages. It is a Western Ghats endemic, restricted to the high elevation (> 1900 meters above sea level (masl)) of the Nilgiri mountains located north of the Palakkad gap, in the Western Ghats (Bhupathy and Kannan 1997). In their range, they are found in abundance on low bushes and hedges (Bhupathy and Kannan 1997). *Salea horsfieldii* is characterized by a laterally compressed body, and heterogeneous dorsal scalation, which includes large, keeled, and imbricate scales. Females of this species are oviparous (captive observation) and lay a clutch of four-to-five eggs (Smith 1935). Adult male *Salea horsfieldii* were reported to possess a dorsal crest discontinuous in height in the nuchal region (Smith 1935). In this study, we promulgate that all juvenile males including hatchlings possessed this sexually dimorphic character. This helped us discriminate between sexes at both adult and juvenile stages.

STUDY AREA

The Nilgiris or “Blue Mountains” is a major part of the Nilgiri Biosphere Reserve. The Nilgiris are situated in the North Western comer of Tamil Nadu in Southern India. They are bounded on the North by the State of Karnataka In the West and South West by Kerala and East and South by the Coimbatore district of Tamil Nadu. The Nilgiris occupies a total area of 2542.49 sq. km (11, 12' and 11, 43' North and 76, 14 and 0 77, 1' East). The elevation of the Nilgiris ranges from 300 meters to about 2,700 meters above mean Sea level.

Nilgiris, as the most forested district of the state, signifies an important stretch of the Western Ghats in Tamil Nadu and is the junction of the Western and Eastern Ghats. The peak of Doddabetta is the second-highest elevation in south India with an altitude of 2637 meters. There are other hills namely Elk Hills, Devarshola Hill, Hulical Hill, and Cairn Hill. The present study was conducted in Upper Nilgiris (1500 m MSL)**.** 10 study sites were taken into consideration for searching for *Salea horsfieldii* in urban areas of Udhagamandalam, the Nilgiris namely Government Arts College and its surrounding 2.Elikal 3.Finger Post 4. Deer Park 5. Boathouse, 6.Kandal 7.Forest gate 8.MPDA (Medicinal plant development Area), 9.Gorishola, and 10.Tamilagam.

METHODOLOGY

Visual Encounter Surveys (VES) involve searching an area or habitat (Campbell and Christman, 1982), and recording *Saleahorsfieldi* encountered. To avoid complications of factors such as visibility, fixed time may be used to survey all habitats to be compared. As in the quadrate method, all microhabitats were searched. Species relative abundance was calculated from this data based on the number of animals located expressed in terms of effort (e.g. encounter/effort). Opportunistic observation in the field and direct observation are very difficult in systematic, stranded, and time-limited studies. However, sometimes-opportunistic direct observation was notated such as feeding, mating, kills, etc. This finding also includes the study on the activity, abundance, and habitat utilization, threats of *Salea horsfieldi* in Udhagamandalam, Nilgiris.

RESULTS

During the study period, a total of 110 individuals of *Salea horsfieldii* were observed in 60 days of survey and 300 man-hours from January to December 2017 in urban areas of Udhagamandalam, Nilgiris, Tamil Nadu. The *Salea horsfieldii* varied from 0 to 8 with a mean of 1.83 ± 1.75. The encounter rate was 0.36 lizards per hour. Among these, 53 (57 %) individuals were males and 44 (43 %) individuals were females. This result shows that a male sex ratio was found in species 1.2: 1 (Male: female). The male range varied from 0 to 6 with a mean of 0.88 ± 1.18 and the encounter rate was 0.17/hrs. The female range varied from 0 to 3 with a mean of 0.73 ± 1.89 and the encounter rate was 0.14/hrs (Table 1)

Table 1. Number of *Salea horsfieldii* recorded in urban areas of Udhagamandalam in Nilgiris

Sex	Number of Individuals	Relative Abundance (%)	Range	Mean ± SD	Encounter Rate
Male	53	57	0-6	0.88 ± 1.18	0.17/hr
Female	44	43	0-3	0.73 ± 1.89	0.14/hrs
Total	110		0-8	1.83 ± 1.75.	0.36/ hrs

The Size class distribution of *Salea horsfieldii* in urban areas Udhagamandalam results showed that among the recorded 110 individuals 65% (n=71) of them were adults followed by Sub adult 23% (n=26) and Juveniles were 12 % (n=13). The adults ranged varied from 0 to 7 with a mean of 1.18±1.57 and the encounter rate was 0.23/hrs. The Subadult range varied from 0 to 2 with a mean of 0.43±0.62 and the encounter rate was 0.08/hrs, and the Juvenile range varied from 0 to 3 with a mean of 0. 21±0.58 and the encounter rate was 0.04/hrs (Table 2).

Table 2.Size class distribution of *Salea horsfieldii* in urban areas of Udhagamandalam in Nilgiris

Size	Number of Individuals	Relative abundance (%)	Range	Mean ± SD	Encounter Rate
Adult	71	65	0-7	1.18 ± 1.57	0.23/hrs
Sub adult	26	23	0-2	0.43 ± 0.62	0.08/hrs
Juvenile	13	12	0-3	0. 21 ± 0.58	0.04/hrs

Among the 65%(n=71) adults 63 % (n=45) of them were males and 37% (n=26) of them were female. The male range varied from 0 to 6 with a mean of 0.75 ± 1 and the encounter rate was 0.15/hrs, and the female range varied from 0 to 3 with a mean 0. 43±0.72 and the encounter rate was 0.08/hrs (Table 3).

Table 3. Adult individuals of *Salea horsfieldii* recorded in urban areas of Udhagamandalam in Nilgiris

Variables	Male	Female
Number of Individuals	45	26
Relative Abundance %	63	37
Range	0-6	0-3
Mean ± SD	0.75 ± 1	0.43 ± 0. 72
Encounter Rate	0.15/hrs	0.08 /hrs

Similar among the 23% (n=26) sub adults 69 % (n=18) of them females and 31% (n=8) of them males. The sub-adult female range varied from 0 to 2 with a mean of 0.3±0.5 and the encounter rate was 0.06/hrs, and the sub-adult males ranged varied from 0 to 2 with a mean 0. 13±0.43 and encounter rate was 0.02/hrs (Table 4).

Table 4. Sub-adults individuals of *Salea horsfieldii* in urban areas of Udhagamandalam in Nilgiris

Variables	Male	Female
Number of Individuals	8	18
Relative Abundance %	31	69
Range	0-2	0-2
Mean ± SD	0. 13 ± 0.43	0.3 ± 0.5
Encounter Rate	0.02/hrs	0.06/hrs

DISCUSSIONS

The present study found the urban areas of Udhagamandalam support a considerable number of the population on *Salea horsfieldii* in Nilgiris. The majority of research available regarding the effects of urbanization on reptiles focuses primarily on species richness or presence/absence data. While most work demonstrates a decrease in population size or species richness with urbanization, a few studies instead find the opposite relationship. Moreno Rueda and Pizarro (2007) found that reptile species richness is positively correlated with human populations, although their focus was primarily on agricultural landscapes associated with urban environments. Similarly, Barrett and Guyer (2008) found that, unlike amphibian species, reptile species significantly increased in urban watersheds in western Georgia USA, likely because of changes in canopy cover. In the present study, it was observed that the endemic *Saleahorsfieldii* have more males sex ratio when compared to females in the Nilgiris. Similarly, the male-biased sex ratio was reported in the protected area of Mukurthi NP (1.1:1, Bhupathy and Nixon 2011). Variations in the sex ratio may have important consequences in the regulation of population. Biased sex ratios could be due to factors such may have important consequences in the regulation of population. Biased sex ratios may because of factors such as the incubation temperature (Lovich 1996). As juveniles of both sexes of *Salea horsfieldii* were monomorphic relative to body shape, dimorphism in adults could be due to differences in growth rates or because of divergence in trajectories during the development of a specific dimorphic trait (Brooks 1991. Manicom *et al* 2014). Urban areas vegetation supports to support a vital habitat for the thriving of *Salea horsfieldii* urban areas of Udhagamandalam in Nilgiris. In general, urbanization tends to decrease native species richness but promotes the diversity of exotic and/or non-native species (McKinney 2006, 2008). Because urbanization can promote the establishment of nonnative and generalist species, there is the potential for urbanization to influence species interactions through the introduction of novel predators, prey, and parasites. The number of invasive species is significantly increasing and is thought to be one of the predominant risks for native species (Pimentel *et al* 2005). Feeding behaviors may also differ for lizards in urban versus forested environments. Anolis lizards in urban environments of Puerto Rico have been observed to be larger and to have longer latency to feeding when offered food (Chejanovski *et al* 2017). Some lizards have even switched foraging modes in response to habitat changes occurring with human presence. Aegean wall lizards (*Podarcis erhardii*) which utilized rock walls were more sedentary, exhibited morphological changes, and ate less sedentary prey compared to non-wall lizards (Donihue 2016). Urbanization can alter abiotic features of an environment, such as temperature, light, and noise, but the direct impacts of these changes on animals are not well understood. Temperature is a dominant ecological variable for all animals that can be altered in urban environments. The majority of studies on temperature changes in urban environments have focused on endothermic species. However, known temperature changes in urban areas likely render ectotherms even more susceptible to urbanization. Decreased shade cover from plants can cause reptiles to be less active due to intense heat. Ackley et al. (2015) demonstrated that irrigated and non-native shade planting increased lizard activity time in urban deserts relative to native landscaping. Similarly, in southeast Arizona, terrestrial lizard abundance decreased in urban areas along with an increase in roadrunners abundance, a common natural predator

(Audsley *et al* 2006), suggesting a causal link. These results provide evidence to suggest that urbanization generally increases the chances of predation from both native and non-native predators. Lastly, it is important to consider that some of these behavioral changes may be the result of morphological shifts in response to urbanization, especially in species with short generation times. A recent study on the effects of urbanization on anti-predator behaviors of fence lizards found urban environments to be associated with shorter limbs, lowered sprint speed, and more frequent tonic immobility (Sparkman *et al* 2018). Interestingly, certain aspects of morphology are overall smaller (e.g., head size) and more asymmetric in urban common wall lizards, suggesting divergent size–shape allometries from those in rural environments (Lazic *et al* 2013, 2015). However, other morphological components are larger, including limb length in urban agamid lizards (*Lophognathus temporalis*) and crested anoles, and greater sub-digital lamellae (i.e., footpad scales) in urban crested anoles (Iglesias *et al* 2012, Winchell *et al* 2016). Urban brown anoles and crested anoles both tend to exhibit greater body sizes (i.e., snout-vent lengths and masses) and body conditions than those in natural environments (Chejanovski *et al* 2017, Hall and Warner 2017).

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