International Journal of Zoology Studies
ISSN: 2455-7269
Impact Factor: RJIF 5.14
www.zoologyjournals.com
Volume 2; Issue 6; November 2017; Page No. 75-77

Observations on some breeding parameters of Kashmir rock agama (*Laudakia tuberculata* Hardwicke & Gray, 1827) from Teetwal Kupwara (Jammu & Kashmir), India

Mehraj Bashir, * Bilal A Bhat, Abdul Lateef Khanday, Mustahson F Fazili, Fayaz Ahmad
Post Graduate, Department of Zoology, University of Kashmir, Srinagar, Jammu & Kashmir, India

Abstract
The observations on some breeding parameters of *Laudakia tuberculata* Hardwicke & Gray, 1827 were carried out in a small pocket of Northwestern Himalaya namely Teetwal in district Kupwara of Jammu & Kashmir from April to September, 2015. The site was selected because of the frequent sightings of lizard. The breeding season started in April and lasted till August. The males were territorial. The lizard was found to be polygamous. The eggs were laid at a single time and the nest was then plugged with soil. The dimensions of seven unhatched eggs (length 1.90 (± 0.94) cm and width 1.0 (± 0.84) cm in) were recorded in the last week of September. Incubation period observed were 39.10 (± 3.07 SD) days. The hatchlings were seen in August and early September. The emergence of hatchlings from 20 nests indicates that clutch size could be around five to seven. The hatchlings were very small and lean and measures 7.60 (± 1.06 SD) cm in length. The average body length of adult males is about 28 (± 2.22 SD) cm and in case of females 21.65 (± 1.34 SD) cm. Results obtained in the present study are promising and indicate that the breeding season coincided with the increasing temperature (required by the eggs for hatching) and availability of more food required by the hatchlings.

Keywords: *Laudakia tuberculata*, breeding, agama, Hardwicke

1. Introduction
Laudakia tuberculata commonly known as Kashmir rock agama occurs in Afghanistan, North Pakistan, India, China, and Nepal. In India, it is widely distributed in the states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand and neighboring states of Uttar Pradesh and Punjab. In Uttarakhand, the species has been reported to occur between 150 and 3600 m elevation (Bahuguna, 2008) [2]. However Waltner (1991) [19] studied the altitudinal ecology of *L. tuberculata* in the Uttar Pradesh state of India and found several dissimilarities among the populations living at different altitudes. The Kashmir rock agama inhabits holes, crevices, and rocky structures near water streams and around human habitations and has been observed to hibernate in the crevices during winter. In the western Himalaya, it can be frequently spotted basking on the rocks and wooden logs and also on the thatches of houses and shops near human habitation (Baig *et al*., 2012) [3].
Although *L. tuberculata* is a well-known and commonly seen agamid lizard of Kashmir, yet the information on its various aspects including breeding biology is lacking from this part of the world. Despite its abundance the lizard has been ignored and preliminary information is available on its ecology, functional anatomy and helminthic parasitism (Das and Walter, 1991; Duda, 1964; Koul, 1977) [7, 11]. The present work is therefore aimed to substantiate the data on the less studied lizard.

2. Materials and Methods
2.1 Study Area and Sampling Procedure
The study was carried out from April to September, 2015 at Teetwal (34°23.368' N, 73°46.227' E, elevation 3447 ft.) in Kupwara District, Jammu & Kashmir. The area is characterized by rocky outcrops, pine forests and barren mountains with sparse vegetation (Figure 1A & C). The study area was chosen as the lizard was easily and very commonly spotted (Figure 1B). Observations were made by spending two days per week from dawn to dusk to record data on breeding aspects of lizard viz., courtship, mating, egg laying and hatching. Twenty specimens were captured randomly by noose method for morphological details and sex differentiation and released back into their habitat. The egg dimensions and colour were recorded from seven unhatched eggs recovered in the last week of September. The data was recorded using field binoculars (Nikon-Aculon A211 10x50) and Camera (Canon EOS 60 D mounted with cannon EF 100 mm macro lens). All the morphological traits were measured by using digital caliper scale. Meteorological measurements (Temperature and Relative humidity) of the study area were obtained from the Meteorological department Srinagar (Table 1).

Fig 1: Study area (Teetwal): A & C; Rocky outcrops B; Adult of *L. tuberculata*

Table 1: Temperature (^{0}C) and Relative humidity (%) of the study area.

Month	Temperature (^{0}C) (SD)	Relative humidity (%)- (SD)
April	20.73 (± 3.44)	66.56 (± 4.88)
May	24.86 (± 4.51)	63.96 (± 4.30)
June	29.20 (± 3.52)	62.73 (± 3.49)
July	32.06 (± 3.35)	69.70 (± 5.78)
August	30.26 (± 2.91)	74.23 (± 3.00)
September	25.30 (± 2.69)	72.56 (± 4.50)

2.2 Mapping of collection site

For mapping (Figure 2) administrative-boundary vector map of Jammu and Kashmir (Google maps) was used. Toposheet for Jammu and Kashmir (Survey of India) was geo-referenced and Teetwal area was digitized for the generation of map. The GPS data of the sampling sites was imported from a GPS device to mapping software (Arc Map). All the mapping was done in ArcGIS package version 10.2.2 (www.esri.com).

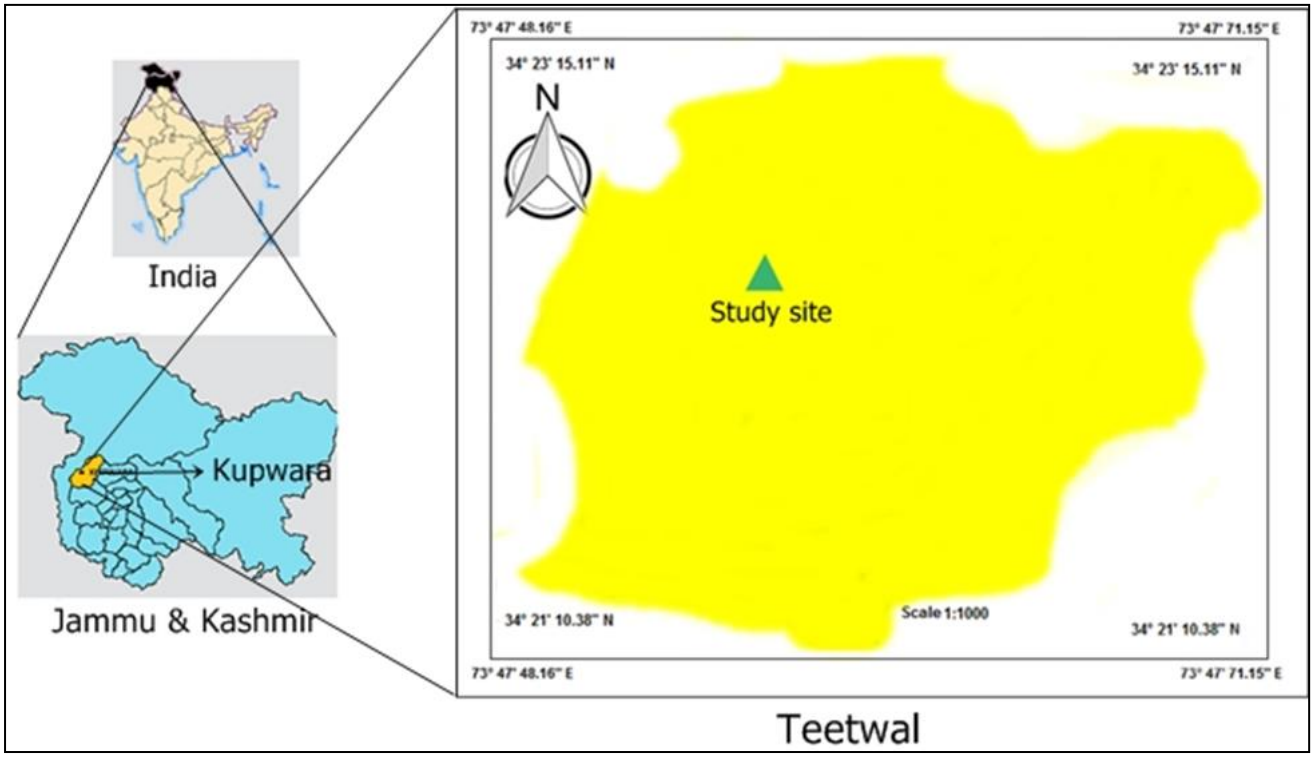

Fig 2: Map showing the Study site (Teetwal) Inset: map of India showing the location of Kupwara

3. Results and Discussion

Breeding in *Laudakia tuberculata* started with courtship in last week of April to second week of August with no special breeding coloration observed in either of the sexes. The courtship and mating behaviour in *Calotes versicolor* coincides with the increasing temperature from May to August (Pandav *et al*., 2007) [14]. In case of *Agama agama* dominant males were brightly coloured with “blue and yellow" nuptial dorsal colouration and bigger size than females (Annibaldii *et al*., 1998). The males of social agamids are also reported to develop colouration during breeding (Harris, 1964) [9]. Males possess red coloured hues on their heads and gular areas in *C. versicolor* (Pandav *et al*., 2007) [14]. By thorough investigation of the 20 specimens of *L. tuberculata* it was found that male could be distinguished from female by a callous patch of scales on belly, a large triangular head and larger body size (Figure 3)

L. tuberculata showed gentle behavior and did not fight with each other except during breeding season when occasional combats between males were noticed. The male was pugnacious and aggressive during breeding season suggesting the territorial behaviour of *L. tuberculata* which is in consonance with Daniel (1983) [6] and Pandav *et al.* (2007) [14]. Gartshore (1985) [8] found solitary species, *A. gracilimembris* usually characterized by reduced nuptial colors in males and no apparent territoriality. *A. agama* males are coloured and territorial during breeding season (Madsen *et al*., 1987) [13].

L. tuberculata was found to be polygamous. Females did not allow males to copulate freely rather males had to run after the female for a long distance and catch them before copulation. Copulation occurred during day time from second week of April upto third week of June. *L. tuberculata* was found to be an oviparous lizard. It laid eggs in shallow depressions made by female in loose soil of hills or sandy river banks using her claws. All the eggs were laid at a single time. The nests were then plugged by soil till hatching. The eggs of *L. tuberculata* were small, oval or bead shaped (Figure 4A). They were dull-white in colour with membranous but tough shells. The average length of eggs is about 1.90 (± 0.94) cm and 1.0 (± 0.84) cm in width. Incubation period observed were 39.10 (± 3.07 SD) days (n=20). The egg hatching (Figure 4B) took place with environmental temperature and hatchlings were seen in August to September. The emergence hatchlings (Figure 4B) from 20 nests indicate that clutch size could be around five to seven. The hatchlings (Figure 4C&D) were very small and lean and measures 7.60 (± 1.06 SD) cm in

length (n=20). The hatchlings resembled their adults (Figure 4E) in all characters except being lighter in color. The average body length of adult males is about 28 (± 2.22 SD) cm and in case of females 21.65 (± 1.34 SD) cm (n=20). There are reports that phenotypic measurements have a direct influence on performance and behavioral activity of lizards (Damme *et al*., 1998). Additional studies on the phenotypic measurements were carried by multiple authors. For instance, between species differences in SVL (Snout Vent Length) have been observed to result in differences in sprint performance (Losos, 1990; Bauwens *et al*., 1995) [4], home range (Turner *et al*., 1969; Perry & Garland, 2002) [15, 17], thermoregulation and daily activity patterns (Stevenson, 1985) [16].

Fig 3: *L. tuberculata* A; Male, B; Female

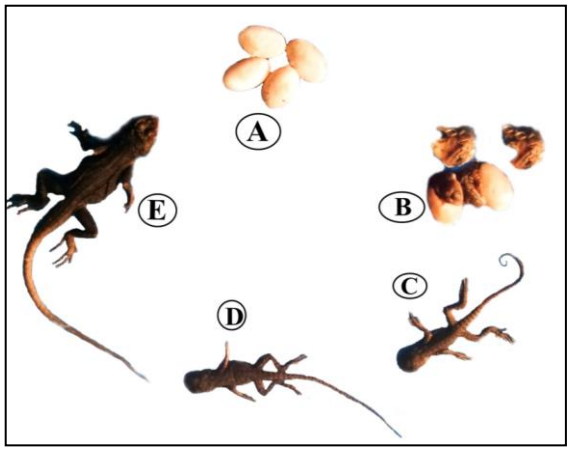

Fig 4: Life cycle of *L. tuberculata* A; Egg stage B; Hatching of eggs C & D; Hatchlings E; Adult

4. Conclusion

Our results agree with previous studies that the breeding season coincided with the increasing temperature (required by the eggs for hatching) and availability of more food required by the hatchlings and thus offer considerable potential for future work such as effect of temperature on phenotypic and behavioral activity of lizards etc. Knowledge on breeding biology of lizards in Kashmir Himalaya remains surprisingly lacking, therefore innovative means of gaining rapid insight into the status of lizards is needed in order to have information about the breeding parameters of lizards in the region; and their conservation could be made effectively possible by framing a proper environmental policy in a time bound manner.

5. References

1. Anibaldi C, Luiselli L, Angelica FM. Notes on the ecology of a sub-urban population of rainbow lizards in coastal Kenya. Afr. J Ecol. 1989: 36(3):199-206.
2. Bahuguna A. Altitudinal Variations in Morphological Characters of *Laudakia tuberculata* Hardwicke and Gray, 1827 from Western Himalayas (Uttarakhand), India. Russian Journal of Herpetology. 2008; 15(3):207-211.
3. Baig KJ, Philipp W, Natalia BA, Wolfgang B. A morphology-based taxonomic revision of *Laudakia* Gray, 1845 (Squamata: Agamidae). Vertebrate Zoology. 2012; 62(2):213-260.
4. Bauwens D, Garland TJ, Castilla AM, Damme VR. Evolution of sprint speed in lacertid lizards: Morphological, physiological and behavioral covariation. Evolution. 1995; 49:848-863.
5. Damme V, Raoul, Bauwens D, Rudolf FV. Thermoregulatory responses to environmental seasonality by the lizard Lacerta vivipara." Herpetologica. 1987, 405-415.
6. Daniel JC. The book of Indian reptiles. Bombay natural history society, 1983.
7. Das SM, Duda PL. Functional anatomy of urinogenital system of *Agama tuberculata* Gray. Kash. Sci. 1964, 53-63.
8. Gartshore ME. *Agama gracilimembris* Chabanaud: 1918 (Reptilia: Sauria: agamidae) in Nigeria. Herpetol. J. 1985; 1(1):23-25.
9. Harris VA. The life of the rainbow lizard. Hutchinson, London, 1964.
10. James CD, Walter GW. An experimental study in phenotypic plasticity in the clutch size of lizard. Oikos. 1994; 70(1):49-56.
11. Koul RK. Studies on Helininth· Parasites of Reptiles of J&K. Ph.D. Thesis. University of Kashmir, 1977.
12. Losos JB, Warheitt KI, Schoener TW. Adaptive differentiation following experimental island colonization in *Anolis* lizards. Nature. 1997; 387:70-73.
13. Madsen T, Lomon J. On the role of colour display in the social and spatial organization of male rainbow lizards (Agama agama). Amphils Reptilia. 1987; 8(4):365-372.
14. Pandav BN, Shanbhag BA, Saidapur SK. Ethogram of courtship and mating behavior of garden lizard *Calotes versicolor*. Current Science. 2007; 93(8):1164-1167.
15. Perry G, Garland T. Lizard home ranges revisited: Effects of sex, body size, diet, habitat, and phylogeny. Ecology. 2002; 83:1870-1885.
16. Stevenson RD. Body size and limits to the daily range of body temperature in terrestrial ectoderm's. The American Naturalist. 1985; 125:102-117.
17. Turner FB, Jennrich RI, Weintraub JD. Home ranges and body size of lizards. Ecology. 1969; 50:1076-1081.
18. Walter WC. Altitudinal ecology of *Agama tuberculata* Gray in western Himalayas. Kansas University, 1991.
19. Waltner RC. Altitudinal ecology of *Agama tuberculata* Gray in the western Himalayas. University of Kansas Museum of Natural History Miscellous Publications, Lawrence. 1991; 83:1-74.