

Climate-Habitat and Conservation Implications for The Indian Spiny-Tailed Lizard in The Bikaner District

Mahendra Singh Solanki¹, Renu Agarwal²

Department of Zoology, Govt. Dungar College Bikaner¹

Department of Botany, Govt. Dungar College Bikaner²

Author E.mail:- Mahendra1980bik@gmail.com

Abstract

The Thar Desert, spanning approximately 200,000 km² across the northwestern Indian subcontinent — primarily Rajasthan, India, and parts of Pakistan — represents one of the most thermally extreme and arid landscapes in Asia. Characterized by intense solar radiation, extreme diurnal and seasonal temperature fluctuations (ranging from below 5°C in winter to above 48°C in summer), low and erratic annual rainfall (100–500 mm), persistent hot winds (*loo*), and sandy to rocky substrate formations, the Thar presents a suite of harsh abiotic stressors that profoundly shape its faunal assemblages. The reptilian fauna is widely distributed in the Thar Desert. Out of 156 species of reptiles from India, as many as 65 species have been reported from the Thar. Crocodylian species, ghariyal, a rare reptilian species is also found in the basin of Chambal river in the Thar. While three species of lizard and tortoise (*Trionyx gangeticus*, *Lissemypunctatapunctata*, *Geochelone elegans*) are commonly found in desert districts of Rajasthan. Among the most ecologically specialized inhabitants of this desert ecosystem is the Indian Spiny-tailed Lizard (*Saara hardwickii*), a large, predominantly herbivorous agamid reptile whose life history, physiology, and behavioral ecology are intricately intertwined with the climatic extremes of this region. The species exhibits sophisticated ectothermic thermoregulation, exploiting the intense solar energy of the Thar to maintain optimal body temperatures (30–42°C) while retreating to deep burrow systems to avoid lethal thermal maxima. The arid climate's influence on vegetation structure — dominated by drought-resistant shrubs such as *Calligonum polygonoides*, *Ziziphus nummularia*, and annual ephemerals — directly governs food availability, reproductive timing, and juvenile survivorship in this species. contemporary climate change pose significant threats to *S. hardwickii* populations. Disruption of the thermal environment and loss of sparse but critical vegetative cover may compress the species' activity window, reduce reproductive success, and degrade burrow site availability. This review synthesizes existing ecological and climatological literature to highlight the vulnerability of *S. hardwickii* to climate-driven habitat change and underscores the necessity of integrating microclimate data into conservation planning for reptile fauna of the Thar Desert.

Keywords: Reptilian Fauna, Thar Desert, Thar Desert, S. Hardwickii.

INTRODUCTION

The Thar Desert extends across India and Pakistan in the Indian subcontinent. As far as the area of the Thar is concerned, 85% of it is located in India and 15% of area is in Pakistan. More than 70% of the Thar Desert in India is in the state of Rajasthan. Apart from this, it extends to Gujarat, Punjab and Haryana. In Pakistan it extends to

Sindh and Punjab. Approximate 70% of Desert area is formed of the sandy soil and the sandy soil forms large sand dunes and these sand dunes keep changing their location with high wind velocity. Thar is the 17th largest hot Deserts in the world and 9th in temperature fluctuations and only 18% of its area is conserved for Desert flora and fauna. Thar is the most densely populated and

biologically diverse Desert in the world. The Thar Desert has a unique and fascinating climate, characterized by extreme temperatures and limited precipitation. The Indian arid tract, commonly known as the "Great Indian Desert" or "Thar Desert", is present in the northwestern part of India.

The Thar Desert is the one of smallest deserts of the world. Though adverse climatic conditions or harsh environment of this region is very uncomfortable for living being even than it is most densely populated desert of the world. Great Indian Thar Desert witnessed geotectonic and climatic changes during the upheaval of Himalaya and several glaciations epochs. Indian Thar Desert is an extension of Sahara Desert, through Arabian and Persian deserts. In India, it extends from Punjab, Haryana, Rajasthan to Gujarat states. Spiny-tailed lizard is one of the herbivorous lizards in the world and it is found in the protected areas surrounding Bikaner city. It belongs to reptile family Agamidae and the Uromasticeae is its subfamily, which comprises of two genera – Saara and Uromastyx. Lizards of genus Saara occur in the desert belt of India, especially in the Thar desert. In the Thar Desert spiny-tailed lizard is also known as Indian spiny-tailed lizard. Spiny-tailed lizard is related to genus Uromastyx and these lizards are restricted to the hot desert of the world. Spiny-tailed lizard is not only found in the Thar Desert but some other parts of Pakistan and Afghanistan. Spiny-tailed lizard is known as "Sanda" in local Marwari language.

METHODOLOGY

Climatic conditions

The seasonal variation of atmospheric pressure over the Bikaner takes place in a systematic manner with a maximum in the winter (January) and a minimum in the monsoon season (July). The pressure gradient over the District generally remains weak except during the late summer and monsoon season. During winter the higher pressure is to the north. In July, the pressure decreases from south to north in Rajasthan.

Study Area Delineation

Select representative sites across Bikaner District (approx. 30,247 km²) covering three microhabitat types: sandy desert plains, scrubland with *Prosopis* and *Calligonum*, and rocky outcrops near Gajner and Kolayat. Use topographic maps (Survey of India 1:50,000) and Google Earth imagery for stratification. Establish 20 permanent quadrats (10×10 m) on a 20 km systematic grid.

Climate Data Collection

Record Two Year 2023 & 2024 abiotic parameters at each quadrat using tools like Lux meter, Temperature meter, Binocular and some data collect from district Metrological Department.

Temperature(Monthly) — max, min, mean at 1.5 m height; 3 readings/day (6:00AM, 12:00N, 6:00PM).

Wind velocity-- data collected from District metrological department.

Relative humidity —digital hygro-thermometer or data collected from District metrological department.

Rainfall — nearest IMD station (Bikaner) + local rain gauges

Habitat Parameter Assessment

In each quadrat, record:

Vegetation cover and species richness (quadrat frame method, 1×1 m subplots)

Burrow density (count/quadrat), dimensions (length, diameter, depth), and compass orientation
Soil texture class via Bouyoucos hydrometer method

Percentage rocky surface, bare ground, and shrub canopy

Anthropogenic disturbance index (grazing intensity, proximity to settlements)

Lizard Population & Ecological Data

Population estimation: Line transect surveys (500 m × 10 m belt); three replicates/season. Supplemented by mark-recapture (toe-clipping + paint marking) for density estimation using Lincoln-Petersen index.

Activity budget: Scan sampling every 30 minutes from 0530–1930 hrs during active season; record basking, foraging, burrowing, and retreat behaviors.

Thermoregulation: Cloacal body temperature at capture (Schultheis/Fluke probe thermometer); selected body temperature (Tsel) in laboratory thermal gradient; operative environmental temperature (Te) using copper lizard models at each microhabitat.

Thermoregulation index: Calculate exploitation index (E = fraction of time within preferred range), accuracy (db = deviation of T_b from T_{sel}), and effectiveness ($Ex = E \times (1 - db)$).

Diet: Fecal pellet and stomach flush analysis; plant fragments identified by epidermal cell technique.

Seasonal Design

Season	Months	Key focus
Pre-breeding/summer	April–June	Thermal maximum, activity peak
Monsoon	July–September	Rainfall effects, vegetation flush
Winter	October–March	Torpor, burrow use, threshold temperatures

RESULTS

Climatic conditions

The seasonal variation of atmospheric pressure over the Bikaner takes place in a systematic manner with a maximum in the winter (January) and a minimum in the monsoon season (July). The pressure gradient over the District generally remains weak except during the late summer and monsoon season. During winter the higher pressure is to the north. In July, the pressure decreases from south to north in Rajasthan.

Temperature

Temperature variation is found in Bikaner district, here maximum temperature in Bikaner occurs in May-June and minimum temperature occurs in November-December (Table1,2)(Figure 1,2,3). During our observations of last 5 years (2020-2024), the maximum temperature ranges from 45 to 49 °C in June-July and it drops down to 9-10 °C in November and December.

Table 1: Mean monthly temperature of the year 2023

S.NO	MONTH	MINIMUM	MAXIMUM
1	January	5.5	22.3
2	February	13.1	31.6
3	March	18.4	32.8
4	April	23.1	36.8
5	May	26	40.5
6	June	27.6	43.1
7	July	27.6	37.3
8	August	27	36.3
9	September	27.2	38.1
10	October	22.8	35.9
11	November	16.9	29.6
12	December	11	26.4

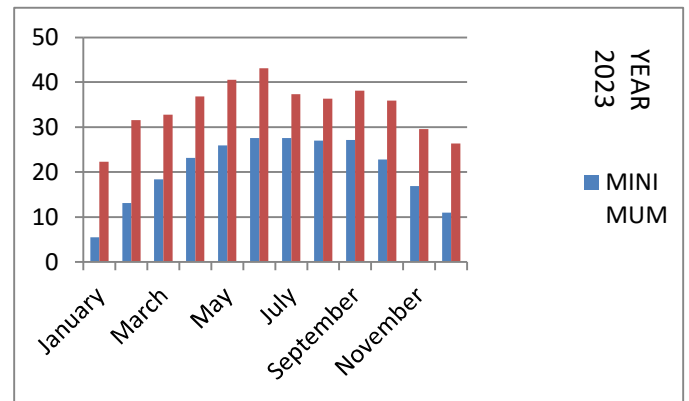


Figure 1: Graph depicting mean monthly temperature during various months of year 2023

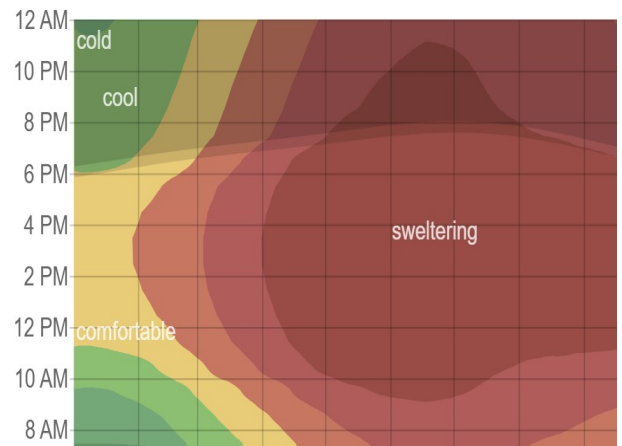


Figure: 2 Average 24 hour weather conditions at Bikaner during various months

Table 2: Mean monthly temperature of the year 2024

S.NO	MONTH	MINIMUM	MAXIMUM
1	January	7.3	20.5
2	February	12.8	25.6
3	March	18.2	32
4	April	24.4	37.1
5	May	29.3	43.9
6	June	30.9	44.4
7	July	29.7	40.3
8	August	27.3	34.6
9	September	26.7	36.7
10	October	23.6	37.5
11	November	17.8	32.3
12	December	9.3	22.9

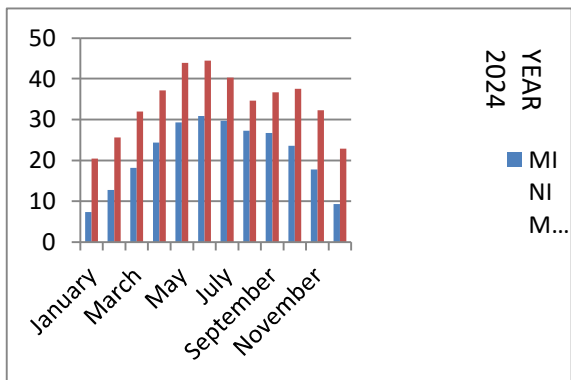


Figure 3: Graph depicting mean monthly temperature during various months of year 2024

Wind velocity

Wind velocity, often interchangeably called wind speed, is a fundamental atmospheric parameter that quantifies the motion of air—its speed and direction. Wind velocity is a dynamic force sculpting landscapes, driving weather systems, powering civilizations. Wind velocity variation in Bikaner region is monthly, maximum velocity is in May, June and July (Table 3),(figures 4,5).

Table 3: Average Wind velocity during two years of study period in Bikaner

S.NO	MONTH	VELOCITY (KM/H) during 2023	VELOCITY (KM/H) during 2024
1	January	1.4	1.4
2	February	1.4	2.3
3	March	2	2.2
4	April	2	1.9
5	May	3.1	1.4
6	June	2.4	2.3
7	July	1.3	1.7
8	August	2.1	1.3
9	September	1.2	0.9
10	October	0.9	0.7
11	November	0.7	0.3
12	December	0.8	0.8

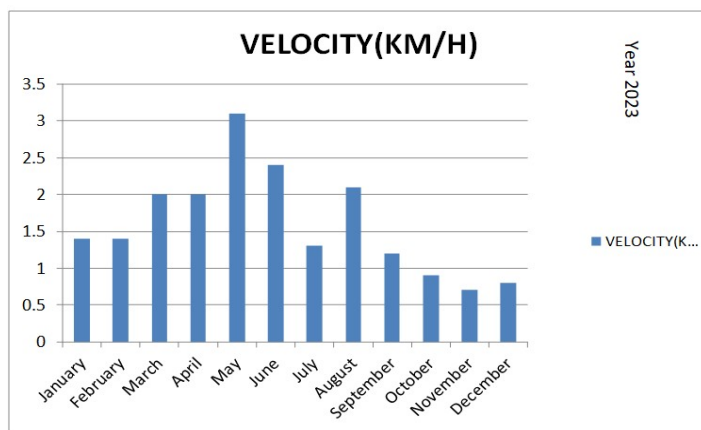


Figure 4: Graph depicting mean monthly wind velocity during the year 2023

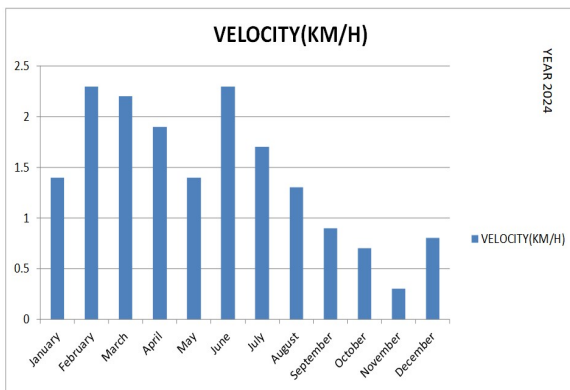


Figure 5: Graph depicting mean monthly wind velocity during the year 2024

S.NO	MONTH	PERCIPITATION (MM) in 2023	PERCIPITATION (MM) in 2024
1	January	0	0.2
2	February	0	3.8
3	March	21.4	0.2
4	April	33.4	18
5	May	111.8	19.8
6	June	3.5	11.5
7	July	0	114.5
8	August	0	122.1
9	September	40	47.8
10	October	5	13
11	November	6.5	0
12	December	0	0.8

Precipitation

In Bikaner, monthly variation of rain fall is observed. Here rain fall occurs due to monsoon or western disturbance. Monsoon season starts from mid-June and continues till August (Table 4),(figure 6).

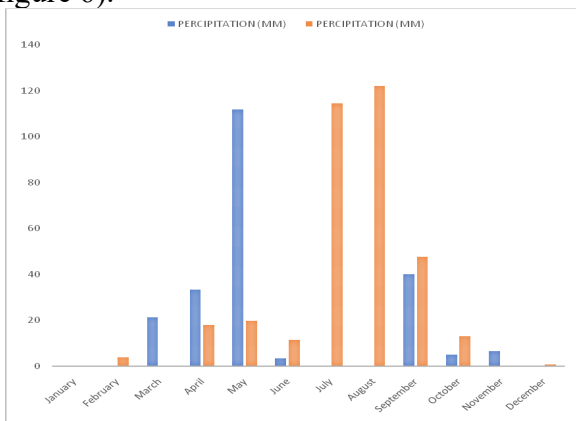


Figure 6: Precipitation during various months of 2023 & 2024

REFERENCES

Amer, S. A. M. and Kumazawa, Y. 2005. Mitochondrial DNA sequences of the Afro-Arabian spiny-tailed lizards (genus *Uromastyx*; family Agamidae): phylogenetic analyses and evolution of gene arrangements. *Biological Journal of the Linnaean Society*, 85: 247–260.

Anderson, J. A. 1964. A report on the gecko *Teratolepifasciata*(Blyth, 1853). *Journal of Bombay Nat. Hist. Soc.* 61:161-171.

Anderson, J. A. 1989. *Zoology of Egypt: Volume First. Reptilia and Batrachia.* London: Bernard Quaritch. lxx + 371 pp. + Plates I-XXX.

Anderson, J. A. 1998. *Zoology of Egypt: Volume First. Reptilia and Batrachia.* London: Bernard Quaritch. 436 pp. (sec. Flower 1933).

Bhandari, M. M. 1978. *Flora of the Indian Desert.* Scientific Publishers, Jodhpur.435pp.

Bhanotar, R. K. Bhatnagar, R. K. 1972. Desert locust upsurge vis-a-vis predatory fauna. *Entomol. News Letter*, 2(8): 53.

Bhanotar, R. K. AND Mahto, Y. 1974. Variability in eye stripes of Desert Locust from a gregaria egg pod. *Entomologist' s Newsletter*, New Delhi, 4 : 43-44.

Bhanotar, R. K. and Srivastava, Y. N. 1985. Impact of reptiles on food production and environment. Non insect pests and predators. *Proc. of the National Symposium on Impact of Non Insect Pests and Predators Food Production and Environment.* March 12–14, 1984 India. All India Scientific Writers Society, pp. 116–120, 265–266.

Cowles, R. B. 1941. Observations on the winter activities of desert reptiles. *Ecology.* 22:125-140.

Cowles, R. B. 1946. Note on the arboreal feeding habits of the desert iguana *Copeia*, 172-173.

Cowles, R. B. 1962. Semantics in bio thermal studies *Science* 135: 670.

Cowles, R. B. and Bogert, C. M. 1944. A preliminary study of the thermal requirements of desert reptiles. *Bull. Am. Museum. Nat. Hist.* 83: 265-296.

Bhanotar, R. K. Bhatnagar, R. K. Srivastav, Y.N. and Mahto, Y. 1973. Preliminary studies on locust hopper predation by *Uromastyx hardwickii*. *Entomol. News Letter*, 3 (3): 19-20.

Johnson, S. R. 1965. An ecological study of the chuckwalla *Sauromalus obesus* Baird, in the western Mojave Desert. *Am. Midland Naturalist* 73:1-29.

Johnson, S. R. 1965. An ecological study of the chuckwalla *Suxriontus solensis* Baird, in the western Mojave Desert. *Am. Midland Naturalist* 73:1-29.

Jolmson, C. R. 1965. The diet of the Pacific fence lizard *Sceloporus occidentalis* (Baird and Girard) from Northern California. *Herpetologica* 21:114-117.

Jorgensen, C. B. and Tanner, W. W. 1963. The applications of the density probability function to determine the home ranges of *Uta stansburiana* and *Chamaeleo phonistigris*. *Herpetologica* 19:105-115.

Wilms, T. M. P. Wagner, M. Shobrak and W. Bhome 2009 b. Activity profiles, habitat selection and seasonality of body weight in a population of Arabian Spiny-tailed Lizards (*Uromastyx aegyptiacus* Blanford, 1875; Sauria: Agamidae) in Saudi Arabia. *Bonner Zoologische Beiträge* 56(4): 259–272.

Wilms, T. M. P. Wagner, M. Shobrak and W. Bhome 2009b. Activity profiles, habitat selection and seasonality of body weight in a population of Arabian Spiny-tailed Lizards (*Uromastyx aegyptiacus* Blanford, 1875; Sauria: Agamidae) in Saudi Arabia. *Bonner Zoologische*.

Wilms, T. M. W. Bhome, P. Wagner, N. Lutzmann and A. Schmitz 2009 a. On the phylogeny and taxonomy of the genus *Uromastyx* Merrem, 1820 (Reptilia: Squamata: Agamidae: Uromastycinae): Resurrection of the Genus *Saara* Gray, 1845. *Bonner Zoologische Beiträge* 56(1/2): 55–99.

Wilms, T. 2005. *Uromastyx: Natural History, Captive Care, Breeding*. Herpeton, Offenbach. 143 pp.