

## Annotated checklist with distribution summary of Snakes of Jawai Community Conservation Reserve, Rajasthan, India

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### Abstract

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We present the first-ever annotated checklist on snakes of the proposed Jawai Community Conservation Reserve of southwestern Rajasthan, India. We opportunistically encountered 26 species of snakes from the study area during the years 2015 to 2017. We have also collated a distribution synopsis for all the observed species with respect to the state of Rajasthan.

**Key words:** Distribution synopsis, habitats, protected area, Rajasthan, Serpentes

### Introduction

On a global scale, biodiversity conservation has compelled competent agencies to establish protected areas consisting of 13% of global land cover (Boucher et al., 2013). As per IUCN guidelines, Community and Conservation Reserves are IUCN type VI protected areas, functioning to provide corridor connectivity between two or more prioritized protected areas, *i.e.*, national parks and wildlife sanctuaries to name a few (Dudley and Stolton, 2008). Endothermic vertebrates such as mammals and birds receive relatively advanced conservation attention, whereas ectothermic vertebrates such as reptiles, amphibians, and fishes are often neglected in terms of conservation investments (Davies et al., 2018). However, a few studies report reptiles from emphasized protected areas in India (Bhatt et al., 1999; Bhupathy, 1999; Radhakrishnan, 1999; Das and Rathore, 2004; Bhatnagar et al., 2010; Ranjan et al., 2021). Furthermore, some studies have given attention to reptile diversity in biodiversity rich areas, such as the Himalayas, the Western Ghats, and Northeastern India (Ahmed et al., 2009; Chettri et al., 2010; Srinivasulu et al., 2014). The Aravalli Hills, India's oldest mountain ranges are inadequately surveyed for reptile diversity assessment (Gaur, 2009). In the southwestern Aravalli mountain ranges, the established Jawai Leopard Conservation Reserve (JLCR) is positioned between Kumbhalgarh Wildlife Sanctuary, Mount Abu Wildlife Sanctuary, Phulwari ki Nal Wildlife Sanctuary, Todgarh-Raoli Wildlife Sanctuary, and Sundha Mata Conservation

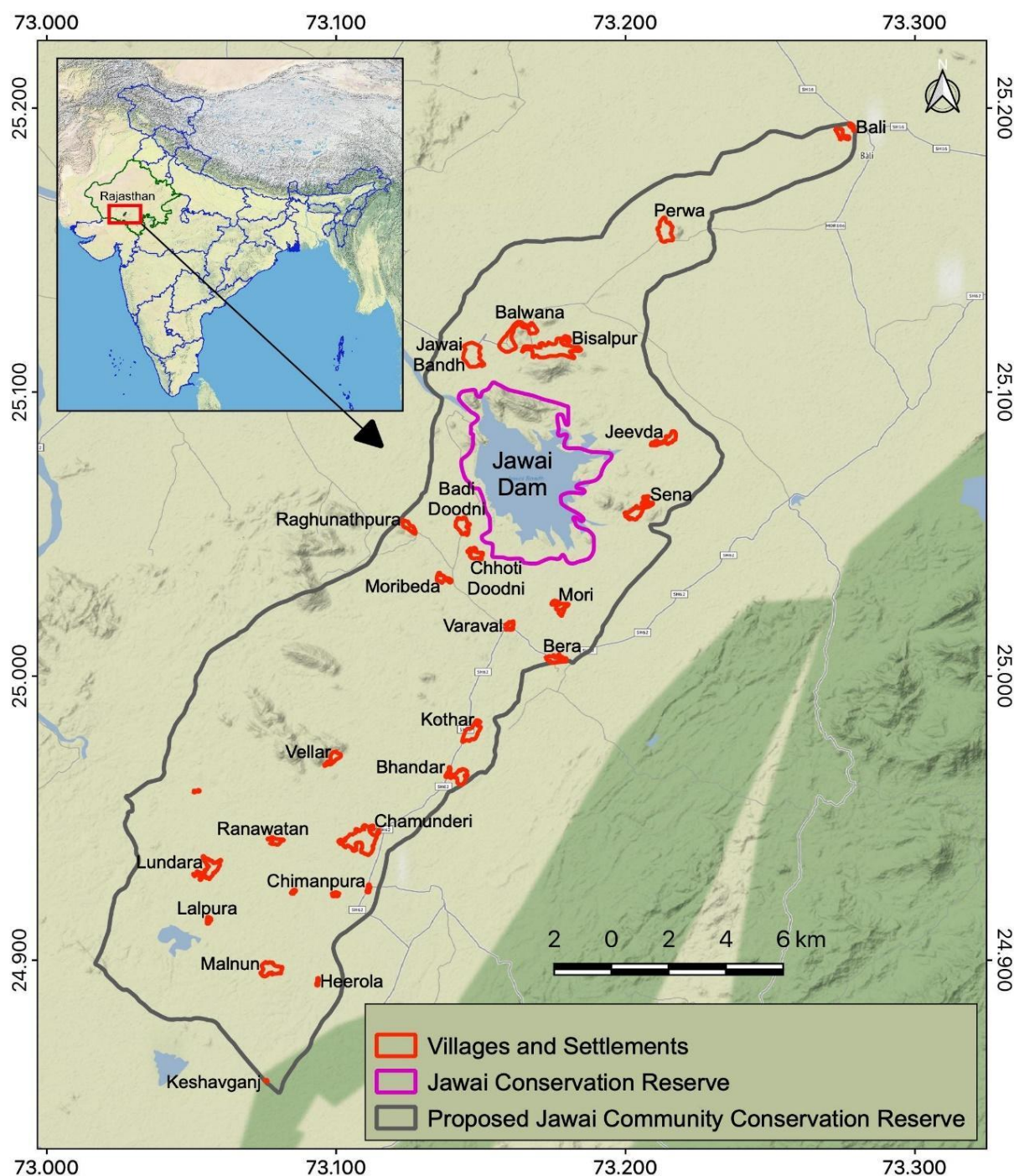
Reserve in Rajasthan, but still lacks studies with respect to reptiles. Prior to conservation, knowledge on species occurrence needs to be procured, which is lacking from the Jawai region regarding reptilian diversity.

The recognized Jawai Leopard Conservation Reserve was proposed to be designated as a Community Conservation Reserve (CCR) in the year 2011 (Sharma, 2017). There are 21 villages (with human density of 263 people/ km<sup>2</sup>) within the limits of the proposed reserve (Sharma, 2017). Being such an area of high human density, it is of significant concern that reptile diversity, especially for snakes should be known at the species level. The need for the proposed assessment originates with the high number of snakebite cases in southeastern Rajasthan with respect to conservation activities (Pandey and Pandey, 2012). On the other hand, habitat degradation caused by the expansion of urban areas is a known reason for population decline and the local extinction of reptilians (Gibbons et al., 2000; Todd et al., 2010). The Jawai region links multiple protected areas, and it contains several areas with high overlap of human settlements and scattered forest cover. Hence, it is essential to identify the snake diversity occupying various habitats in Jawai. Looking at the available information, we made as our goal the species assessment of snake diversity in the proposed Jawai Community Conservation Reserve. Also, we compiled a synopsis of the distribution of the observed species with respect to the state of Rajasthan.

**Study Area**

The established 19 km<sup>2</sup> JLCR (25.206°N 73.001°E–24.859°N 73.285°E; Fig. 1) has been proposed to be made a CCR by expanding its area to 309 km<sup>2</sup> (Sharma, 2017). This proposed CCR is envisioned to function as a multiple-use (IUCN type-VI) protected area (Dudley and Stolton, 2008), covering a large human-dominated landscape. The reserve covers semiarid regions of southwestern Rajasthan in western India.

The CCR has a mean annual temperature of 25 °C (16 °C–34 °C) and a mean annual precipitation of 462 mm (350–614 mm) (IMD, 2020). Dry deciduous and thorny vegetation, such as *Diospyros melanoxylon*, *Butea monosperma*, *Scyzygium cumini*, *Azadirachta indica*, *Cassia fistula*, *Ziziphus jujube*, *Euphorbia hierta*, *Cassia* spp., *Prosopis cineraria*, *Acacia nilotica* are present and invasive plant species such as *Prosopis juliflora* are distributed across the landscape.



**Figure 1:** Map of study area representing proposed Jawai Community Conservation Reserve in Rajasthan, India.

## Material and Methods

We assessed the species richness of snakes through opportunistic observations in the proposed Jawai CCR (Hutchens and DePerno, 2014). In fact, opportunistic reptile observations increase in urbanized areas on the fringes of forests (Magura et al., 2004), so the data related to observed habitats from which an individual snake was recorded, was also collected. Briefly, habitats were classified into seven types, such as Rupicolous (rocks and boulders), Grassland (where the natural vegetation height is shorter than 30 cm), Scrubland (where the natural vegetation height is more 30 cm, with sparse distribution of bushes), Plantation (a cultured or natural forest with tall trees; tree height more than two meters), Wetland (where the wetland is within approximately 100 meters), Human habitation (the human-dominated areas), and Agricultural fields (crops or harvested farms). The observed activity period (*i.e.*, dawn, dusk, day, or night) of the snake was also recorded. The study was conducted in the study area between January 2015 and April 2017. We identified the snake species through multiple photographs taken by a Canon EOS 1100D camera after referring to published literature and field guides, such as Whitaker and Captain (2004), Daniel (2002), and further validated by experts as well. We also photographed road-kills and included their records in the species list. Red list and schedule statuses for the recorded snake species were obtained from the IUCN red list portal and Wildlife (Protection) Act, 1972 of India (WLPA, 1972; IUCN, 2021).

Identifications of *Ahaetulla laudankia* Deepak, Narayanan, Sarkar, Dutta and Mohapatra, 2019 and *Platyceps plinii* (Merrem, 1820) were made following comparison with closely related species based on recent taxonomic developments by Deepak et al. (2019 and 2020), respectively. Two referred specimens of *A. laudankia* were collected from Mount Abu, Rajasthan (around 50 km from the study area; Deepak et al., 2019). One specimen of *P. plinii* was referred from Hemawas Dam (around 70 km from the study area; Deepak et al., 2021).

We extracted the distribution records of observed species from various protected areas and districts of Rajasthan state by reviewing previously published studies (Khan et al., 2020; Nath et al., 2021). Requirement of the distribution summary through the literature review was much needed since numerous publications are available only in print version journals, *namely* Cobra (new series), Fauna and Flora, and restricted access journals mentioning the reptile diversity of Rajasthan.

## Results and Discussion

We observed a total of 26 species of snakes throughout the study area (Table 1; Fig. 2). We found

that the members of the Family Colubridae were dominant (16 species), followed by Boidae (2 species), Elapidae (2 species), Viperidae (2 species), Typhlopidae (2 species), Psammophiidae (1 species), and Pythonidae (1 species). Based on the number of observations, we recorded eight rarely encountered species during the study: *Ahaetulla laudankia* Deepak, Narayanan, Sarkar, Dutta and Mohapatra, 2019, *Platyceps plinii* (Merrem, 1820), *Platyceps gracilis* (Günther, 1862), *Dendrelaphis tristis* (Daudin, 1803), *Lycodon striatus* (Shaw, 1802), *Rhabdophis plumbicolor* (Cantor, 1839), *Spalerosophis atriceps* (Fischer, 1885), and *Daboia russelii* (Shaw and Nodder, 1797). Several recent IUCN red list assessments provided the insights on the status of listed species, out of which three Near Threatened, 21 Least Concern, one Data Deficient and one not evaluated species are recorded in our study area (Table 1). Only one species, *Python molurus* is listed under Schedule I, and four species, namely *Fowlea piscator*, *Ptyas mucosa*, *Naja naja*, *Daboia russelii* are enlisted under Schedule-II and the remaining 21 species under Schedule-IV of the Indian Wildlife Protection Act, 1972. In the overview, four species are known to be venomous, five mildly venomous, and 18 non-venomous.

In the current study, we found a gradient of habitat vulnerability of snake species richness in the landscape, *viz.*, Scrubland (number of species  $n=19$ ), Agricultural fields ( $n=17$ ), Human habitations ( $n=15$ ), Plantation ( $n=10$ ), Rupicolous ( $n=8$ ), Grassland ( $n=8$ ), and Wetland ( $n=5$ ; Table 1). *Naja naja* has been found most dominant with regards to habitats (number of habitats  $n=7$ ), followed by *Eryx johnii* ( $n=6$ ), *Lycodon aulicus* ( $n=5$ ), and so on (Table 1).

In Rajasthan, 71300 snakebite cases were reported during 2003–2015 (Suraweera et al., 2020), with an almost 50% absolute mortality risk. More than 100 snakebite cases are reported per district every year representing an almost 70% absolute risk of human mortality in southeastern Rajasthan (Suraweera et al., 2020). Many of these envenomation cases include envenomation by big four venomous snakes of India, *i.e.*, *Bungarus caeruleus*, *Naja naja*, *Echis carinatus*, and *Daboia russelii* (Pandey and Pandey, 2012; Mahur et al., 2019). All the big four venomous snakes are reported in the present study area. Thus, understanding such occurrence and diversity might help in future snakebite mitigation measures using a modelling approach. The present study fills the research gap in distribution and data deficient status of snakes of western India, which was considered as a gap in research and conservation (Böhm et al., 2013). Such studies should be conducted frequently outside of protected areas, especially from high human-density areas. This is imperative from the point of view of both wildlife conflict and conservation.



**Figure 2:** Observed species of snakes in proposed Jawai Leopard Community Conservation Reserve: A. *Eryx conicus* (Schneider, 1801) Common Sand Boa. B. *Eryx johnii* (Russell, 1802) Red Sand Boa. C. *Ahaetulla laudankia* Deepak, Narayanan, Sarkar, Dutta and Mohapatra, 2019 Laudankia Vine Snake. D. *Amphiesma stolatum* (Linnaeus, 1758) Buff-striped Keelback. E. *Platyceps plinii* (Merrem, 1802) Banded Racer. F. *Boiga trigonata* (Schneider, 1802) Common Cat Snake. G. *Coelognathus helena* (Daudin, 1803) Common Trinket Snake. H. *Dendrelaphis tristis* (Daudin, 1803) Common Bronzeback Tree Snake. I. *Fowlea piscator* (Schneider, 1799) Checkered Keelback. J. *Lycodon aulicus* (Linnaeus, 1758) Common Wolf Snake. K. *Lycodon striatus* (Shaw, 1802) Barred Wolf Snake. L. *Oligodon arnensis* (Shaw, 1802). Common Kukri Snake M. *Oligodon taeniolatus* (Jerdon, 1853) Russell’s Kukri Snake. N. *Platyceps gracilis* (Günther, 1862) Graceful Racer. O. *Platyceps ventromaculatus* (Gray, 1834) Glossy-bellied Racer. P. *Ptyas mucosa* (Linnaeus, 1758) Oriental Rat Snake. Q. *Rhabdophis plumbicolor* (Cantor, 1839) Green Keelback. R. *Spalerosophis atriceps* (Fischer, 1885) Black-headed Royal Snake. S. *Bungarus caeruleus* (Schneider, 1801) Common Krait. T. *Naja naja* (Linnaeus, 1758) Spectacled Cobra. U. *Psammophis leithii* (Günther, 1869) Leith’s Sand Snake. V. *Python molurus* (Linnaeus, 1758) Indian Rock Python. W. *Grypotyphlops acutus* (Duméril and Bibron, 1844) Beaked Worm Snake. X. *Indotyphlops braminus* (Daudin, 1803) Brahminy Blind Snake. Y. *Daboia russelii* (Shaw and Nodder, 1797) Russell’s Viper. Z. *Echis carinatus* (Schneider, 1801) Saw-scaled Viper. AA. Roadkill of *P. leithii* Leith’s Sand Snake. AB. Roadkill of *P. mucosa* Oriental Rat Snake.

**Table 1:** Snake species recorded in Proposed Jawai Community Conservation Reserve during study period with distribution summary in Rajasthan state.

S. No	Family	Zoological Name	Common Name	IUCN Red list Status	Observed Habitat(s)	Observed Activity Period	Previous Records in Rajasthan
1	Boidae	<i>Eryx conicus</i> (Schneider, 1801)	Common Sand Boa (Fig. 2-A)	Near Threatened (Srinivasulu et al., 2021A)	2, 3, 6, 7	Day	Bassi WLS, Ranthambhore NP and TR, Sariska TR, Sitamata WLS (Bhatnagar et al., 2010; Kumar et al., 2010; Yaseen et al., 2011; Bhatnagar et al., 2013); Jawai (Sharma et al., 2014); Keoladeo NP (Prakash, 1988; Bhupathy, 1999); Kumbhalgarh WLS (Gaur and Pandey, 2007; Gaur and Sharma, 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Aravalli foothills (Gaur, 2009) Baghdarrah (Udaipur), Tonk (Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jodhpur (Biswas and Sanyal, 1977); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014)
2	Boidae	<i>Eryx johnii</i> (Russell, 1801)	Red Sand Boa (Fig. 2-B)	Near Threatened (Anderson et al., 2021)	2, 3, 4, 5, 6, 7	Dawn, Dusk and Night	Bassi WLS, Sariska TR, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C; Yaseen et al., 2011; Bhatnagar et al., 2013); Desert National Park (Das and Rathore, 2004; Sharma and Rathore, 2004; Bhatnagar et al., 2013); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A; Gaur and Sharma, 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Tal Chhappar WLS (Kumar and Gaur, 2009); Aravalli foothills (Gaur, 2009) Ajmer, Bikaner, Chittorgarh, Jaipur, Jodhpur, Kota, Nagaur, Pali (Blanford, 1879; Biswas and Sanyal, 1977; Sharma and Vazirani, 1977; Sharma, 1996; Bhatnagar et al., 2013); Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Barmer, Jaisalmer (Gala and Khandal, 2010; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014)
3	Colubridae	<i>Ahaetulla laudankia</i> . Deepak, Narayanan, Sarkar, Dutta and Mohapatra, 2019	Laudankia Vine Snake (Fig. 2-C)	Least Concern (Mohapatra and Vyas, 2021)	4	Night	Darrah WLS, Todgarh Raoli WLS (Bhatnagar et al., 2013); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 1995A; Sharma, 1997A; Sharma, 2007A; FES, 2010B); Bhatnagar et al., 2013); Ranthambhore NP (Kumar et al., 2010); Aravalli foothills (Gaur, 2009) Mount Abu (Sirohi; Biswas and Sanyal, 1977; Deepak et al., 2019); Sirohi (Sharma, 1996; Bhatnagar et al., 2013)
4	Colubridae	<i>Amphiesma stolatum</i> (Linnaeus, 1758)	Buff-striped Keelback (Fig. 2-D)	Least Concern (Wogan et al., 2021A)	2, 3, 6, 7	Day	Bassi WLS (Yaseen et al., 2011); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C) Kota, Udaipur (Bhatnagar et al., 2013)
5	Colubridae	<i>Boiga trigonata</i> (Schneider, 1802)	Common Cat Snake (Fig. 2-F)	Least Concern (Srinivasulu et al., 2021B)	3, 6, 7	Dawn and Night	Bassi WLS, Jaisamand WLS, Todgarh Raoli WLS (Yaseen et al., 2011; Bhatnagar et al., 2013); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010); Aravalli foothills (Gaur, 2009) Ajmer (Blanford, 1879); Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jaipur, Jodhpur (Sharma and Vazirani, 1977; Sharma, 1996; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014)
6	Colubridae	<i>Coelognathus helena</i> (Daudin, 1803)	Common Trinket Snake (Fig. 2-G)	Least Concern (Ganesh and Wickramasinghe, 2021)	3, 4, 6	Day and Night	Bassi WLS (Yaseen et al., 2011); Kumbhalgarh WLS (FES, 2010A; Gaur and Sharma, 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Aravalli foothills (Gaur, 2009) Ajmer, Jaipur, Sirohi, Udaipur (Blanford, 1879; Biswas and Sanyal, 1977; Sharma, 1996; Bhatnagar et al., 2013); Bagdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Mount Abu (Sirohi; Biswas and Sanyal, 1977)

Table 1. (Continued)

S.No	Family	Zoological Name	Common Name	IUCN Red list Status	Observed Habitat(s)	Observed Activity Period	Previous Records in Rajasthan
7	Colubridae	<i>Dendrelaphis tristis</i> (Daudin, 1803)	Common Bronze-back Tree Snake (Fig. 2-H)	Least Concern (Wickramasinghe and Ganesh, 2021)	3	Day	Bassi WLS, Jaisamand WLS, Kumbhalgarh WLS, Mount Abu WLS, Sajjangarh WLS, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010A; FES, 2010C; Yaseen et al., 2011; Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010) Baghdarrah (Udaipur), Torna (Udaipur), Kamalnath (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jhadol (Udaipur), Ogana (Udaipur; Sharma, 1994)
8	Colubridae	<i>Fowlea piscator</i> (Schneider, 1799)	Checkered Keelback (Fig. 2-I)	Least Concern (Stuart et al., 2021)	5, 6, 7	Dusk and Night	Bassi WLS, Jaisamand WLS, Todgarh Raoli WLS (Yaseen et al., 2011; Bhatnagar et al., 2013); Jawai Dam (Sharma and Vazirani, 1977; Sharma et al., 2014); Keoladeo NP (Prakash and Nanjappa, 1988; Bhupathy, 1999); Kumbhalgarh WLS (Gaur and Pandey, 2007; FES, 2010A; Gaur and Sharma, 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Aravalli foothills (Gaur, 2009) Ajmer, Chittorgarh, Dungarpur, Bhilwara, Jodhpur, Pali, Sirohi, Udaipur (Blanford, 1879; Biswas and Sanyal, 1977; Sharma and Vazirani, 1977; Sharma, 1996; Sharma and Rathore, 2007; Bhatnagar et al., 2013); Bagdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jalore (Gala and Khandal, 2010; Bhatnagar et al., 2013); Sheoganj (Sirohi; Sharma et al., 2014); Mount Abu (Sirohi; McCann, 1946; Biswas and Sanyal, 1977)
9	Colubridae	<i>Lycodon aulicus</i> (Linnaeus, 1758)	Common Wolf Snake (Fig. 2-J)	Least Concern (Wogan et al., 2021B)	2, 3, 4, 6, 7	Night	Bassi WLS (Yaseen et al., 2011), Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A); Nahargarh WLS (Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Aravalli foothills (Gaur, 2009) Ajmer, Chittorgarh, Jodhpur (Blanford, 1879; Biswas and Sanyal, 1977; Sharma, 1996; Bhatnagar et al., 2013); Baghdarrah (Udaipur), Jaipur (Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jhadol (Udaipur; Sharma, 1999); Kambeshwar (Pali; Sharma et al., 2014)
10	Colubridae	<i>Lycodon striatus</i> (Shaw, 1802)	Barred Wolf Snake (Fig. 2-K)	Least Concern (Papenfuss et al., 2021)	7	Dusk	Bassi WLS, Nahargarh WLS (Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010) Ajmer (Blanford, 1879); Jaipur (Bhatnagar et al., 2013); Kamalnath (Udaipur; Sharma, 1995B; Sharma, 1995C)
11	Colubridae	<i>Oligodon amensis</i> (Shaw, 1802)	Common Kukri Snake (Fig. 2-L)	Least Concern (Das et al., 2021)	1, 3, 4, 6, 7	Day and Night	Bassi WLS, Jaisamand WLS, Kumbhalgarh WLS, Mount Abu WLS, Sajjangarh WLS, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010A; FES, 2010C; Yaseen et al., 2011; Bhatnagar et al., 2013); Keoladeo NP (Bhupathy, 1999); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B) Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013)
12	Colubridae	<i>Oligodon taeniolatus</i> (Jerdon, 1853)	Russell's Kukri Snake (Fig. 2-M)	Least Concern (Srinivasulu et al., 2021C)	2, 3, 4, 6, 7	Dawn and Dusk	Bassi WLS, Jaisamand WLS, Kumbhalgarh WLS, Sajjangarh WLS, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010A; Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010) Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Ajmer (Blanford, 1879)
13	Colubridae	<i>Platyceps gracilis</i> (Günther, 1862)	Graceful Racer (Fig. 2-N)	Data Deficient (Srinivasulu et al., 2013A)	1	Day, Dusk and Night	Chirwa Ghata RF, Jaisamand WLS, Keora ki Nal RF, Sajjangarh WLS, Todgarh Raoli WLS (Sharma et al., 2012A; Bhatnagar et al., 2013) Aaspur (Dungarpur), Udaipur (Sharma et al., 2012A; Bhatnagar et al., 2013); Jhadol (Udaipur; Sharma, 2007; Sharma and Nagar, 2007)
14	Colubridae	<i>Platyceps plinii</i> (Merrem, 1820)	Banded Racer (Fig. 2-E)	Not Evaluated	7	Day and Dusk	Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2013); Aravalli foothills (Gaur, 2009) Pratapgarh (Bhatnagar et al., 2013)

Table 1. (Continued)

S. No	Family	Zoological Name	Common Name	IUCN Red list Status	Observed Habitat(s)	Observed Activity Period	Previous Records in Rajasthan
15	Colubridae	<i>Platyceps ventromaculatus</i> (Gray, 1834)	Glossy-bellied Racer (Fig. 2-O)	Least Concern (Behbehani et al., 2021)	2, 3, 6, 7	Day and Dusk	Desert NP (Das and Rathore, 2004; Bhatnagar et al., 2013); Ranthambhore NP (Kumar et al., 2010); Aravalli foothills (Gaur, 2009) Bikaner, Jaipur, Jaisalmer, Jodhpur, Pali, Udaipur (Biswas and Sanyal, 1977; Sharma and Vazirani, 1977; Sharma, 1996; Bhatnagar et al., 2013; Solanki et al., 2015; Kumawat and Purohit, 2021); Churu (Gala and Khandal, 2010; Bhatnagar et al., 2013); Sikar (Whitaker and Captain, 2004)
16	Colubridae	<i>Ptyas mucosa</i> (Linnaeus, 1758)	Oriental Rat Snake (Figs. 2-P, 2-AB)	Least Concern (Wogan et al., 2021C)	1, 3, 4, 6, 7	Day	Bassi WLS (Yaseen et al., 2011); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A; Gaur and Sharma, 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Aravalli foothills (Gaur, 2009) Ajmer, Jodhpur, Pali (Blanford, 1879; Sharma and Vazirani, 1977; Sharma, 1996; Bhatnagar et al., 2013); Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014); Mount Abu (Sirohi; McCann, 1946)
17	Colubridae	<i>Rhabdophis plumbicolor</i> (Cantor, 1839)	Green Keelback (Fig. 2-Q)	Least Concern (Wickramasinghe et al., 2021)	5	Day and Dusk	Bassi WLS, Goraniya Ghata RF, Kamalnath RF, Kumbhalgarh WLS, Jaisamand WLS, Madri RF, Mount Abu WLS, Nalsandol RF, Phulwari ki Nal WLS, Sajjangarh WLS, Samoli RF, Sitamata WLS, Todgarh Raoli WLS, Ubheshwar RF (Sharma, 1997A; Sharma, 2007A; FES, 2010A; FES, 2010B; FES, 2010C; Sharma et al., 2012B; Gaur and Sharma, 2013); Aravalli foothills (Gaur, 2009) Bhim (Rajsamand), Khairwara (Udaipur), Kota, Mangalwar (Chittorgarh), Nagpahad (Ajmer), Sayra (Udaipur), Sirohi, Sultanpur (Sawaimadhopur), Mount Abu (Sirohi; McCann, 1946; Biswas And Sanyal, 1977; Sharma, 1996; Sharma et al., 2012B; Bhatnagar et al., 2013) Keoladeo NP (Mukherjee, 2015); Nahargarh WLS, Sariska TR (Bhatnagar et al., 2013); Aravalli foothills (Gaur, 2009)
18	Colubridae	<i>Spalerosophis atriceps</i> (Fischer, 1885)	Black-headed Royal Snake (Fig. 2-R)	Least Concern (Srinivasulu, 2021)	1, 3	Day	Ajmer, Jaipur, Jhunjhunu (Bhatnagar et al., 2013); Bikaner, Jodhpur, Pali (Sharma, 2007B; Kumawat and Purohit, 2021); Nagaur (Biswas and Sanyal, 1977; Sharma, 1996; Bhatnagar et al., 2013); Western Rajasthan (Whitaker and Captain, 2004)
19	Elapidae	<i>Bungarus caeruleus</i> (Schneider, 1801)	Common Krait (Fig. 2-S)	Least Concern (Mohapatra et al., 2021)	3, 4, 5, 6, 7	Night	Bassi WLS (Yaseen et al., 2011); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Phulwari ki Nal WLS (Sharma, 2007A; FES, 2010B); Kumbhalgarh WLS (FES, 2010A); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Tal Chhappar WLS (Kumar and Gaur, 2009); Todgarh Raoli WLS (Bhatnagar et al., 2013); Aravalli foothills (Gaur, 2009) Ajmer (Blanford, 1879); Baghdarrah (Udaipur), Bhilwara, Mandal (Bhilwara), Menal (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Barmer, Churu, Jalore (Gala and Khandal, 2010; Bhatnagar et al., 2013); Bikaner, Jaisalmer, Jodhpur (Biswas and Sanyal, 1977; Sharma, 1996; Bhatnagar et al., 2013)
20	Elapidae	<i>Naja naja</i> (Linnaeus, 1758)	Spectacled Cobra (Fig. 2-T)	Least Concern (de Silva et al., 2021)	1, 2, 3, 4, 5, 6, 7	Day and Night	Bassi WLS (Yaseen et al., 2011); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (Gaur and Pandey, 2007; FES, 2010A); Phulwari ki Nal WLS (Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Tal Chhappar WLS (Kumar and Gaur, 2009); Aravalli foothills (Gaur, 2009) Ajmer, Jaipur, Jaisalmer, Jodhpur (Blanford, 1879; Sharma, 1996; Bhatnagar et al., 2013); Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Barmer (Gala and Khandal, 2010; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014); Mohammadpur (Alwar; Sharma, 1992); Mount Abu (Sirohi; McCann, 1946)

**Table 1. (Continued)**

S. No	Family	Zoological Name	Common Name	IUCN Red list Status	Observed Habitat(s)	Observed Activity Period	Previous Records in Rajasthan
21	Psammophiidae	<i>Psammophis leithii</i> Günther, 1869	Leith's Sand Snake (Figs. 2-U, 2-AA)	Least Concern (Vyas et al., 2021)	3	Day	Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010) Achrol (Jaipur; Bhatnagar et al., 2013); Jaisalmer (Solanki et al., 2015); Rajasthan (Whitaker and Captain, 2004)
22	Pythonidae	<i>Python molurus</i> (Linnaeus, 1758)	Indian Rock Python (Fig. 2-V)	Near Threatened (Aengals et al., 2021)	1, 7	Dawn, Dusk and Night	Bassi WLS, Bhainsroadgarh WLS, Sariska TR, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C; Yaseen et al., 2011; Bhatnagar et al., 2013); Keoladeo NP (Dubey, 1984; Sridharan and Manohar, 1984; Bhupathy, 1999); Kumbhalgarh WLS (Gaur and Pandey, 2007; FES, 2010A; Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Aravalli foothills (Gaur, 2009) Ajmer (Blanford, 1879); Baghdarrah (Udaipur), Borawas (Kota; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Kambeshwar (Pali; Sharma et al., 2014)
23	Typhlopidae	<i>Grypotyphlops acutus</i> (Duméril and Bibron, 1844)	Beaked Work Snake (Fig. 2-W)	Least Concern (Srinivasulu et al., 2013B)	1, 3	Night	Jaisamand WLS, Sajjangarh WLS (Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; FES, 2010B) Baghdarrah (Udaipur; Neemachmata Hills (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jodhpur (Sharma, 1996; Bhatnagar et al., 2013)
24	Typhlopidae	<i>Indotyphlops braminus</i> (Daudin, 1803)	Brahminy Blind Snake (Fig. 2-X)	Least Concern (Shea et al., 2021)	2, 3, 6, 7	Day	Bassi WLS (Yaseen et al., 2011); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (Gaur and Sharma, 2013; Bhatnagar et al., 2013); Nahargarh WLS, Sajjangarh WLS, Sariska TR, Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C; Bhatnagar et al., 2013); Phulwari ki Nal WLS (Sharma, 1997A; Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Aravalli foothills (Gaur, 2009) Ajmer, Bhilwara, Bikaner, Jodhpur, Pali (Jhnujhuu), Udaipur (Blanford, 1879; Biswas and Sanyal, 1977; Sharma and Vazirani, 1977; Sharma, 1996; Kumar and Rathore, 2007; Bhatnagar et al., 2013); Baghdarrah (Udaipur), Jaipur (Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014)
25	Viperidae	<i>Daboia russelii</i> (Shaw and Nodder, 1797)	Russell's Viper (Fig. 2-Y)	Least Concern (Suraj et al., 2021)	3	Dusk	Bassi WLS, Sariska TR, Todgarh Raoli WLS (Yaseen et al., 2011; Bhatnagar et al., 2013); Jawai (Sharma et al., 2014); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010; Bhatnagar et al., 2013); Sitamata WLS (Bhatnagar et al., 2010; FES, 2010C); Aravalli foothills (Gaur, 2009) Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Jodhpur (Sharma, 1996; Bhatnagar et al., 2013); Kambeshwar (Pali), Sheoganj (Sirohi; Sharma et al., 2014); Mount Abu (Sirohi; McCann, 1946)
26	Viperidae	<i>Echis carinatus</i> (Schneider, 1801)	Saw-scaled Viper (Fig. 2-Z)	Least Concern (Ananjeva et al., 2021)	1, 3, 4, 6, 7	Night	Bassi WLS, Jaisamand WLS, Sajjangarh WLS, Sariska TR, Todgarh Raoli WLS, (Yaseen et al., 2011; Bhatnagar et al., 2013); Desert NP (Das and Rathore, 2004; Sharma and Rathore, 2004; Bhatnagar et al., 2013); Keoladeo NP (Bhupathy, 1999); Kumbhalgarh WLS (FES, 2010A); Phulwari ki Nal WLS (Sharma, 2007A; FES, 2010B); Ranthambhore NP (Kumar et al., 2010); Sitamata WLS (Bhatnagar et al., 2010); Tal Chhappar WLS (Kumar and Gaur, 2009); Aravalli foothills (Gaur, 2009) Ajmer, Barmer, Bhilwara, Bikaner, Jaisalmer, Jalore, Jodhpur, Nagaur, Pali, Sirohi (Blanford, 1879; Biswas and Sanyal, 1977; Sharma and Vazirani, 1977; Sharma, 1996; Gala and Khandal, 2010; Bhatnagar et al., 2013; Kumawat and Purohit, 2021); Baghdarrah (Udaipur; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2013); Bardod (Alwar; Bhatnagar et al., 2013); Kambeshwar (Pali; Sharma et al., 2014); Mount Abu (Sirohi; Biswas and Sanyal, 1977)

Abbreviations for habitat: 1 – Rupicolous; 2 – Grassland; 3 – Scrub; 4 – Plantation; 5 – Near Wetland; 6 – Human Habitation; 7 – Agricultural field.

Abbreviations used in article: CR – Conservation Reserve; FES – Foundation for Ecological Security; NP – National Park; RF – Reserve Forest; TR – Tiger Reserve; WLS – Wildlife Sanctuary; IUCN – International Union for Conservation of Nature and Natural Resources



A study by Bhatnagar et al. (2013) portrayed *Ahaetulla* cf. *nasuta* (here *Ahaetulla laudankia*), *Psammophis leithii*, *Amphiesma stolatum*, *Dendrelaphis tristis*, *Platyceps gracilis*, *Argyrogena fasciolata* (here *Platyceps plinii*), and *Gryptotyphlops acutus* as rare species in Rajasthan, which were also recorded in Jawai, our study area. Habitat-centric conservation approaches can be helpful to conserve these species in the human-modified landscape. Some of the listed species found in Jawai are also reported from the southern extent of Rajasthan, e.g., *Dendrelaphis tristis*, *Gryptotyphlops acutus*, *Lycodon striatus*, *Rhabdophis plumbicolor* (Table 1; McCann, 1946; Sharma, 1994; Sharma, 1995A; Sharma, 1997A; Gaur and Pandey, 2007; Sharma and Nagar, 2007; Bhatnagar and Mathur, 2008; Bhatnagar et al., 2010; FES, 2010A; 2010B; 2010C; Yaseen et al., 2011; Sharma et al., 2012B). Furthermore, recorded snake diversity was observed to be richer in Jawai than nearby protected areas in Rajasthan, such as Bassi WLS (16 species by Yaseen et al., 2011), Ranthambhore NP (23 species by Kumar et al., 2010), Sitamata WLS (18 species by Bhatnagar et al., 2010), Keoladeo NP (14 species by Bhupathy, 1999), Kumbhalgarh WLS (20 species by FES, 2010A), Phulwari ki Nal WLS (24 species by FES, 2010B), Desert NP (n= 3 by Das and Rathore, 2004), and Talchhappar WLS (n= 4 by Kumar and Gaur, 2009). Some of the studies were conducted long ago and need to be revised to know the current status. Further, numerous protected areas such as Jhalana RF, Jawahar Sagar WLS, Sundhamata CR, Bandh Baratha WLS, Kesarbagh WLS, Sawai Man Singh WLS, and Van Vihar WLS need to be appropriately surveyed with respect to herpetofaunal diversity and ecology to fill the wide research gaps.

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### Conflict of interest

The authors declare that there are no conflicting issues related to this research article.

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