



Updated Checklist of Snakes with the First Record of *Spalerosophis arenarius* in Gujarat and Range Extensions of Five Species of Snakes in the Northern Region of Gujarat, India

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Abstract.—A complete checklist of herpetofaunal species is required in order to understand species richness and distribution, especially of reptiles. India has a total of 279 snake species, whereas Gujarat only has 60, leaving many opportunities for researchers to further investigate snake diversity in the state. The purpose of this study is to explore snake diversity in the northern region of Gujarat state, a region which comprises five districts, including four protected habitats. The data was collected through surveying forested habitat, examining road kills, and collecting rescue data from volunteers. The study recorded a total of 32 species from seven families showing a high diversity of snake species in the study area. Among them, *Spalerosophis arenarius* (Boulenger, 1890) was recorded for the first time in the state. With 22 species, Colubridae is the most commonly occurring snake family of the area. North Gujarat has a rich diversity of snakes and we suggest more detailed research on snake diversity and distribution in the future.

Reptiles play an important role in conserving biodiversity and comprise a quarter of all vertebrate species (Mittermeier et al. 1992). Systematic lists of snakes or any animal within any geographic area are crucial to understand species richness and distribution (Kalki et al. 2021). India has recorded a total of 518 species of reptiles; among them 53.86% (279) are species of snakes (Dinesh et al. 2015). However, snake diversity in Gujarat state is considerably less compared to national species richness. A recent study on snake diversity in Gujarat found around 60 species (Vyas 2007; Patel and Vyas 2019). There are several studies that have been published about snake diversity in different regions, sanctuaries, and cities of Gujarat (Bhalodia et al. 2001, 2003; Naik et al. 1993; Vyas 2004a, 2004b, 2004c; Patel et al. 2018, 2019a). Despite this, several parts of Gujarat remain unexplored.

The northern part of Gujarat comprises five districts, which account for various types of habitats. Forests are mainly found on the foothills of Aravalli in the Banaskantha,

Sabarkantha, and Aravalli Districts; whereas, Patan and Mahesana Districts are primarily flat. This area lacks any systematic study of wildlife, especially reptiles. Here, we provide a checklist of snake diversity in the North Gujarat region including natural and urban areas. It comprises data gathered from 2018 to 2021 from many visits to North Gujarat. This information will enumerate the current number of species and their distribution in the northern part of Gujarat and should provide baseline data for future snake research in the area.

Methods

Study area.—The northeastern part of Gujarat is classified as North Gujarat (Fig.1). It extends between 23.5877°N–24.5158°N and 72.4130°E–73.4130°E. The area falls into the semi-arid biogeographic zone-4, and Biotic province 4B of the Gujarat Rajwada, and has few natural forests. Further, it can be classified as sub biotic province 4B3 by having a hilly area (Sabarkantha, Aravali, and Banaskantha Districts) that contains dry teak, mix dry deciduous, *Boswellia* forest, dry

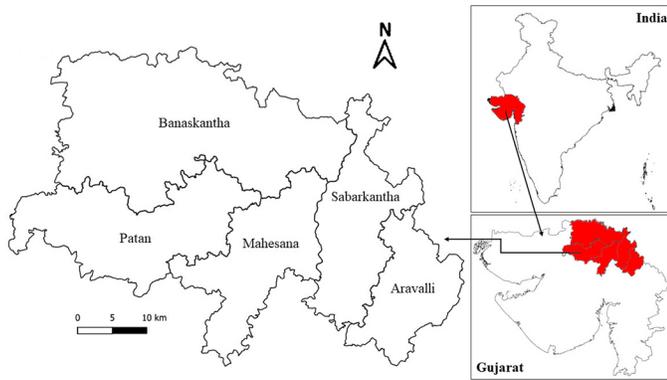


Fig. 1. Map of the region studies in northern Gujarat, India.

scrub forest, and bamboo patches. The sub biotic 4B4 contains arid lands (Mehsana and Patan) containing few riverine patches of forest, desert, and wetlands (Singh 2001; Dharaiya and Gajera 2008). The study area contains four protected habitats: the Jessore Wildlife Sanctuary, the Ambaji-Baram Sanctuary in Banaskantha District, Polo Reserve Forest in Sabarkantha District, and Thol Bird Sanctuary in Mahesana District. These protected areas only cover 2% of the total area of North Gujarat (Dharaiya and Gajera 2008).

The forests of North Gujarat are classified under subgroup 5A—southern tropical dry deciduous forest and 6B—northern tropical thorn forest. The forest is dominated by *Tectona grandis*, *Agle marmelosa*, *Acasia catechu*, *Butia monosperma*, *Boswellia* sp., *Cassia auriculata*, *Prosopis chilensis*, *Anogeissus* sp., and Bamboo. The area has a variety of faunal species including 175 species of migratory and resident birds. A wide variety of mammals also inhabit this forest to desert area, including the Indian Leopard (*Panthera pardus fusca*), the Sloth Bear (*Melursus ursinus*), the Asiatic Wild Ass (*Equus hemionus khur*), the Indian Fox (*Vulpus bengalensis*), and the Indian Pangolin (*Manis crassicaudata*). The area has three distinct seasons: Winter, summer, and monsoon.

Surveys.—A survey of snakes was carried out from May 2019 to January 2022. Data was collected through opportunistic field observations by occasionally surveying forests, attending rescue calls, noting roadkill, and gathering data from other rescuers and forest officials, photographers, and professional herpetologists. Our survey was entirely dependent on the availability of resources and volunteers. All individuals were photographed in the field or at rescue locations and we also tried to collect GPS coordinates with a hand-held GPS or mobile app. All observed snake species were categorized according to International Union for Conservation of Nature’s Red List of Threatened Species (international status; IUCN, 2021), the Convention on International Trade in Endangered Species (internationally; CITES), and according to the five different schedules of the Indian Wildlife (Protection) Act, 1972 (nationally; IWPA).

Results and Discussion

In our study, we recorded a total of 32 species of snakes. Family Colubridae had the highest species diversity with 22 species, and Viperidae was represented by only three species. Elapidae and Erycidae were each represented by two species. Lamprophiidae, Pythonidae and Typhlopidae only had one species of each family distributed in the area (Fig. 2).

Among them, one species, the Red-spotted Royal Snake (*Spalerosophis arenarius*) was recorded for the first time on the periphery of Gujarat (Fig. 3). It was recorded in the agriculture and wasteland areas in the southwest part of Banaskantha District. In addition, five snake species were recorded for the first time in the North Gujarat region: The Green Vine Snake (*Ahaetulla oxyrhyncha*; Fig. 3), Laudankia Vine Snake (*Ahaetulla laudankia*), Common Bronze-back Treesnake (*Dendrelaphis tristis*; Fig. 3), and Duméril’s Black-headed Snake (*Sibynophis subpunctatus*; Fig. 3) from the Colubridae family; and the Common Green Pitviper (*Craspedocephalus gramineus*; Fig. 3) from the Viperidae family. These five species were earlier reported from the south, central, and Saurashtra regions of Gujarat but not in the northern part of Gujarat; findings of the present study redefine the distribution ranges of five species in Gujarat (Patel and Vyas 2016, Patel et al. 2019b).

Regarding the conservation status of species, 27 species were listed as Least Concern (LC), which accounts for 84% of the total record (Table 1). Only four species are listed as Near Threatened (NT) (*Platyceps gracilis*, *Spalerosophis atriceps*, *Wallaceophis gujaratensis*, and *Python molurus*) whereas *Spalerosophis arenarius* is listed as Data Deficient (DD) (IUCN 2022), a situation which needs to be rectified by systematic research. All snake species recorded in the study are protected under the Indian Wildlife (Protection) Act, 1972, in which 26 of the species are protected under schedule IV, four are protected under Schedule II (*Bungarus caeruleus*,

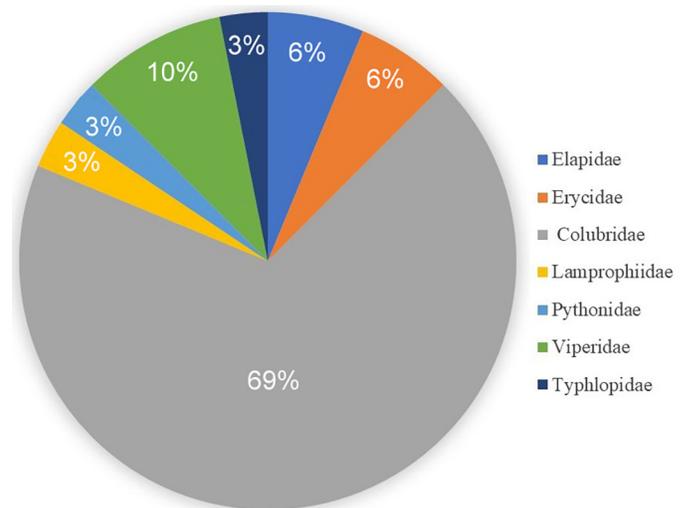


Fig. 2. Percentage of snake species from six families recorded from northern Gujarat, India, in this study.

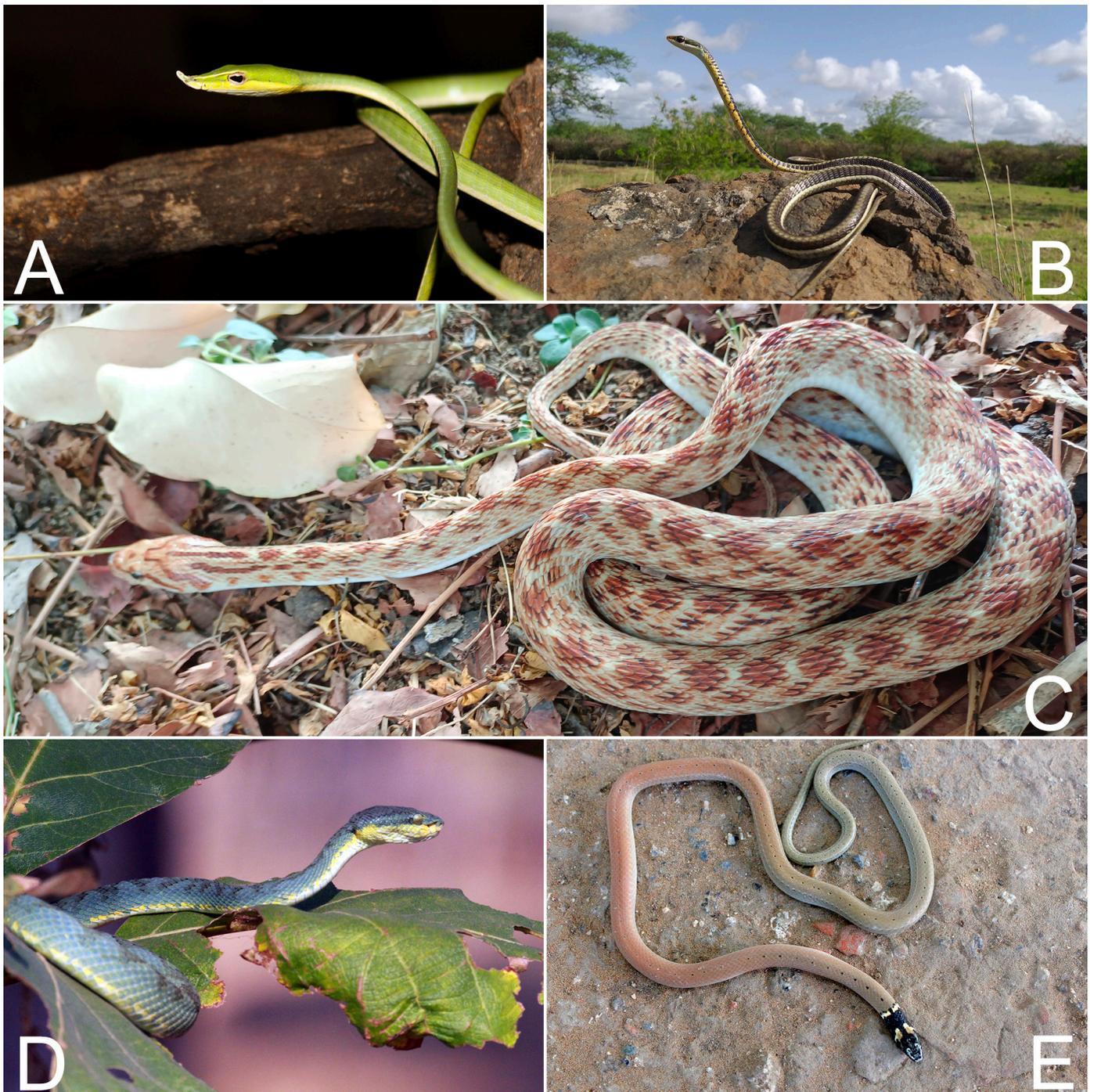


Fig. 3. Representative snake species found during this study in northern Gujarat, India: *Ahaetulla oxyrhyncha* (A), *Dendrelaphis tristis* (B), *Spalerosophis arenarius* (C), *Craspedocephalus gramineus* (D), and *Sibynophis subpunctatus* (E). Photographs by Jaydeep Maheta, Ranjit Thakor, and Atulsinh Zala.

Naja naja, *Ptyas mucosa*, and *Daboia russelii*), and two species under Schedule I (*Python molurus* and *Elachistodon westermanni*) (www.wiievis.nic.in). However, the Appendices of CITES have only listed three species: *Python molurus* (Appendix I), *Naja naja* (Appendix II), and *Daboia russelii* (Appendix III) (CITES 2022). The northern part of Gujarat is always neglected in terms of scientific study; our study will act as a base for future studies related to reptilians in the area. Several part wildlife habitats are vulnerable due to rising

numbers of tourists and mining. Increasing the frequency of future research studies in this area will undoubtedly help get the attention of authorities regarding conservation of the local forest habitats.

A photographic voucher of *Ahaetulla oxyrhyncha* (ZRC(IMG)2.599), *Dendrelaphis tristis* (ZRC(IMG)2.600), *Craspedocephalus gramineus* (ZRC(IMG)2.601), *Sibynophis subpunctatus* (ZRC(IMG)2.602), *Spalerosophis arenarius* (ZRC(IMG)2.603), and *Ahaetulla laudankia* (ZRC(IMG)2.605)

Table 1. List of snake species of northern Gujarat, India, including information about IUCN and CITES status and protection level under the Indian Wildlife (protection) Act, 1972.

Family	Species	IUCN	CITES	Indian Wildlife (Protection) Act, 1972
Elapidae	<i>Bungarus caeruleus</i> (Schneider 1801)	LC		Sch. II
	<i>Naja naja</i> (Linnaeus 1758)	LC	App. II	Sch. II
Erycidae	<i>Eryx conicus</i> (Schneider 1801)	LC		Sch. IV
	<i>Eryx johnii</i> (Russell 1801)	LC		Sch. IV
Colubridae	<i>Ahaetulla oxyrhyncha</i> (Lacépède 1789)	LC		Sch. IV
	<i>Ahaetulla laudankia</i> (Deepak et al. 2019)*	LC		Sch. IV
	<i>Amphiesma stolatum</i> (Linnaeus 1758)	LC		Sch. IV
	<i>Platyceps plinii</i> (Shaw 1802)	LC		Sch. IV
	<i>Boiga forsteni</i> (Duméril, Bibron and Duméril 1854)	LC		Sch. IV
	<i>Boiga trigonanta</i> (Schneider 1802)	LC		Sch. IV
	<i>Boiga westermanni</i> (Reinhardt 1863)	LC		Sch. I
	<i>Coelognathus helena</i> (Daudin 1803)	LC		Sch. IV
	<i>Dendrelaphis tristis</i> (Daudin 1803)	LC		Sch. IV
	<i>Fowlea piscator</i> (Schneider 1799)	LC		Sch. IV
	<i>Lycodon aulicus</i> (Linnaeus 1758)	LC		Sch. IV
	<i>Lycodon striatus</i> (Shaw 1802)	LC		Sch. IV
	<i>Oligodon arnensis</i> (Shaw 1802)	LC		Sch. IV
	<i>Oligodon taeniolatus</i> (Jerdon 1853)	LC		Sch. IV
	<i>Platyceps gracilis</i> (Günther 1862)	NE		Sch. IV
	<i>Platyceps ventromaculatus</i> (Gray 1834)	LC		Sch. IV
	<i>Ptyas mucosa</i> (Linnaeus 1758)	LC		Sch. II
	<i>Sibynophis subpunctatus</i> (Duméril, Bibron and Duméril 1854)	LC		Sch. IV
	<i>Spalerosophis arenarius</i> (Boulenger 1890)	DD		Sch. IV
	<i>Spalerosophis atriceps</i> (Fischer 1885)	NE		Sch. IV
<i>Rhabdophis plumbicolor</i> (Cantor, 1839)	LC		Sch. IV	
<i>Wallaceophis gujaratensis</i> (Mirza et al. 2016)	NE		Sch. IV	
Lamprophiidae	<i>Psammophis leithii</i> (Günther 1869)	LC		Sch. IV
Pythonidae	<i>Python molurus</i> (Linnaeus 1758)	NE	App. I	Sch. I
Viperidae	<i>Daboia russelii</i> (Shaw and Nodder 1797)	LC	App. III	Sch. II
	<i>Echis carinatus</i> (Schneider 1801)	LC		Sch. IV
	<i>Craspedocephalus gramineus</i> (Shaw 1802)	LC		Sch. IV
Typhlopidae	<i>Indotyphlops braminus</i> (Daudin 1803)	LC		Sch. IV

were deposited at the Lee Kong Natural History Museum, National University of Singapore. The identification of the species was confirmed from photographs by Dr. Amit Sayeed.

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