

New Species of Rock-Dwelling *Hemidactylus* (Squamata: Gekkonidae) from Gujarat, India

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ABSTRACT.—A new species of *Hemidactylus* gecko (Squamata: Gekkonidae) is described from Girnar in the Junagadh district of Gujarat, India. This medium-sized, chiefly rupicolous gecko may be distinguished from its south Asian congeners by having 12–16 rows of irregularly arranged, flattened to weakly conical dorsal tubercles, 7–9 subdigital lamellae on digit I of the pes and 10–11 on digit IV, and 12–14 femoral pores on each thigh separated by a median diastema. This is the second *Hemidactylus* currently regarded as endemic to Gujarat and the 10th member of the genus recorded for the state.

Hemidactylus, with more than 85 recognized species, is the second most speciose genus of gekkonid lizards in the world (Kluge, 2001; Carranza and Arnold, 2006; Bauer et al., 2007; Giri and Bauer, 2008). It is widely distributed throughout much of the Old World tropics and subtropics as well as in the Mediterranean region and in the Americas. In south Asia, it is the dominant genus of nocturnal gecko, with representatives in all but the most inhospitable alpine and subalpine habitats. Twenty-four species are currently recognized as occurring in the Republic of India (Giri and Bauer, 2008; Bauer et al., 2008). These include taxa previously assigned to the genera *Lophopholis*, *Dravidogecko*, and *Teratolepis*—all of which have been synonymized with *Hemidactylus* (Loveridge, 1947; Bauer and Russell, 1995; Bauer et al., 2008). However, the validity of two of the species described from India, *Hemidactylus subtriedrus* Jerdon and *Hemidactylus mahendrai* Shukla, has recently been questioned (Zug et al., 2007), and the occurrence of *Hemidactylus karenorum* (Theobald) outside of Myanmar has also been called into doubt (Zug et al., 2007; Mahony and Zug, 2008).

With its varied topography and environmental conditions, the western Indian state of Gujarat harbors a diverse reptile fauna, including representatives of nine *Hemidactylus* (Gayen, 1999; Sharma, 2000; Vyas, 2000a,b, 2007; Vyas et al., 2006). Most of these are widely distributed across India and also occur in adjacent countries or are even broadly distributed across large areas of Asia (Tikader and Sharma, 1992; Vyas

et al., 2006). However, an apparently endemic species, *Hemidactylus porbandarensis* (Sharma, 1981) also occurs in the state, and recently a southwest Asian/Mediterranean species, *Hemidactylus persicus* Anderson, has been recorded for the first time in India from Gujarat (Vyas et al., 2006). The unique position of Gujarat, at the junction of the northern end of the Western Ghats and a diversity of arid and semiarid habitats that extend northward and eastward into Rajasthan and southern Pakistan (Fig. 1), suggests that reptile diversity may yet be underestimated. This is further suggested by the example of adjacent Maharashtra, where, with moderate field efforts, numerous new amphibian and reptile species have been identified in the last five years (Giri et al., 2003a; Giri et al., 2004; Giri, 2008; Giri and Bauer, 2008). As part of an effort to document the biodiversity of this region of India, herein we describe a new species of *Hemidactylus* from the Girnar Hills on the Saurashtra Peninsula in Gujarat.

MATERIALS AND METHODS

The following measurements were taken with digital calipers (to the nearest 0.1 mm): snout-vent length (SVL; from tip of snout to vent), trunk length (TRL; distance from axilla to groin measured from posterior edge of forelimb insertion to anterior edge of hind-limb insertion), body width (BW; maximum width of body), crus length (CL; from base of heel to knee); tail length (TL; from vent to tip of tail), tail width (TW; measured at widest point of tail); head length (HL; distance between retro-articular process of jaw and snout-tip), head

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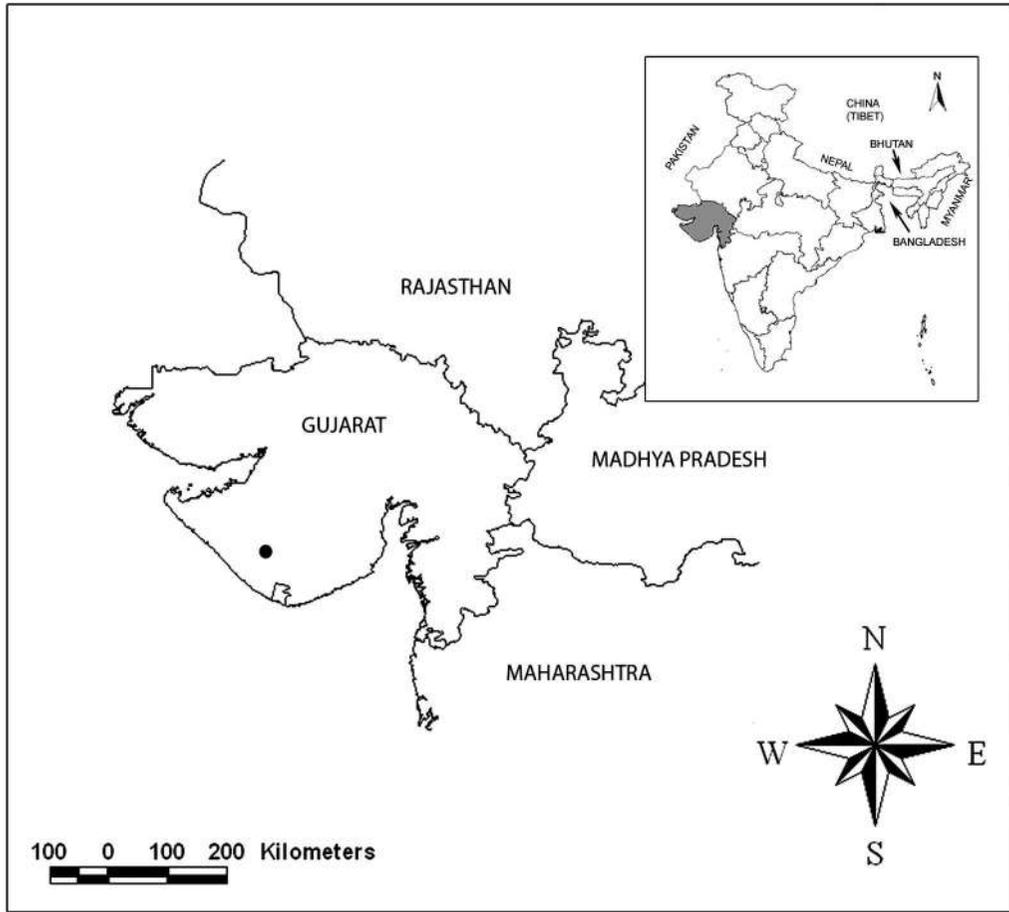


FIG. 1. Map of Gujarat indicating the position of the type locality of *Hemidactylus gujaratensis* sp. nov. on the Saurashtra Peninsula. Inset shows the position of Gujarat (shaded) within India, with the positions of neighboring countries indicated.

width (HW; maximum width of head), head height (HH; maximum height of head, from occiput to underside of jaws), forearm length (FL; from base of palm to elbow); orbital diameter (OD; greatest diameter of orbit), nares to eye distance (NE; distance between anteriormost point of eye and nostril), snout to eye distance (SE; distance between anteriormost point of eye and tip of snout), eye to ear distance (EE; distance from anterior edge of ear opening to posterior corner of eye), ear length (EL; longest dimension of ear), internarial distance (IN; distance between nares), interorbital distance (IO; shortest distance between left and right supraciliary scale rows). Scale counts and external observations of morphology were made using a Wild M5 dissecting microscope.

SYSTEMATICS

Hemidactylus gujaratensis sp. nov.

Figures 2–6

Holotype.—Bombay Natural History Society (BNHS) 1818 (Fig. 2), an adult female from Vagheshwari Mata Temple, Junagadh City, Junagadh District, Saurashtra Peninsula, Gujarat, Gujarat, India ($21^{\circ}31.348'N$, $70^{\circ}28.863'E$, 179 m asl), collected by Sunny Patil and Raju Vyas on 27 October 2007.

Paratypes.—BNHS 1813–1814, adult females, and BNHS 1812, 1815, subadult males. Same collection data as holotype.

Etymology.—The species is named for the western Indian state of Gujarat.

Diagnosis.—A medium-sized *Hemidactylus*, SVL to at least 65.0 mm. Twelve to 14 rows of

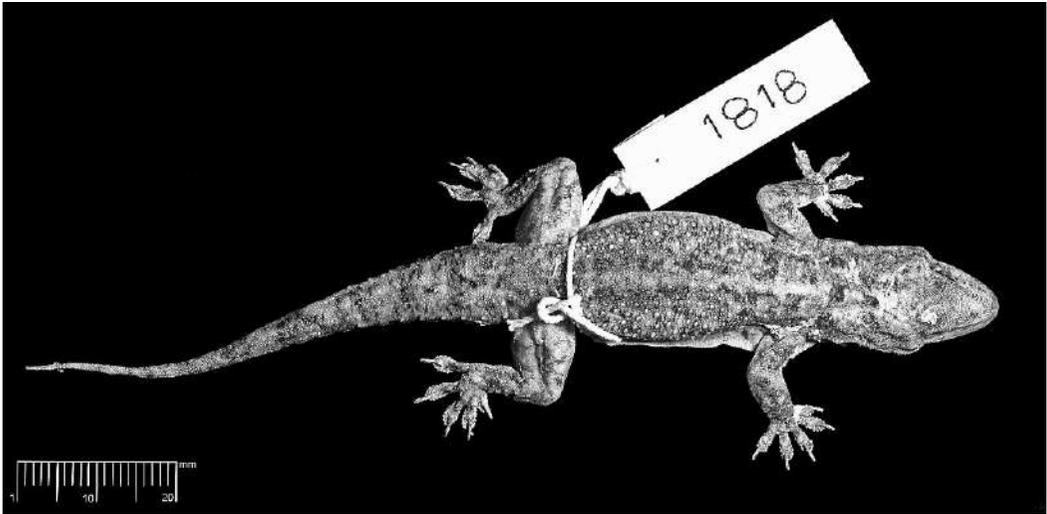


FIG. 2. Holotype (BNHS 1818, adult female) of *Hemidactylus gujaratensis* sp. nov. in dorsal view.

irregularly arranged, flattened to weakly conical tubercles. First supralabial scale narrowly contacting nasal. Two well-developed pairs of postmentals, the inner pair larger and in broad contact behind mental. Ventrolateral folds in-

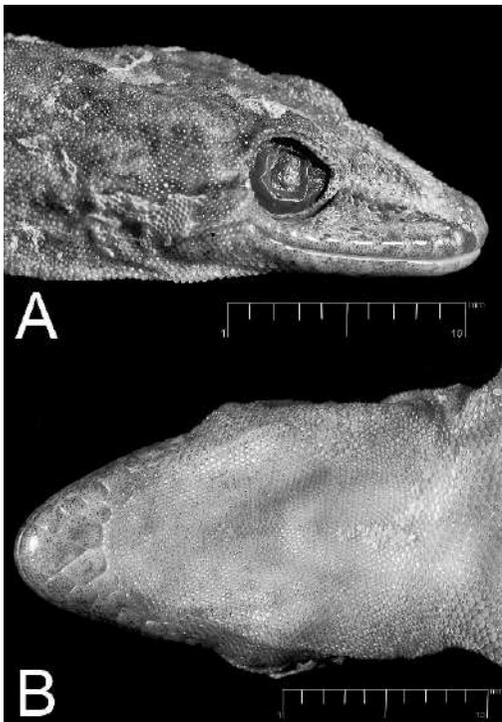


FIG. 3. (A) Lateral view of head of *Hemidactylus gujaratensis* sp. nov. holotype, BNHS 1818. (B) Ventral view of head of *H. gujaratensis* sp. nov. holotype, BNHS 1818.

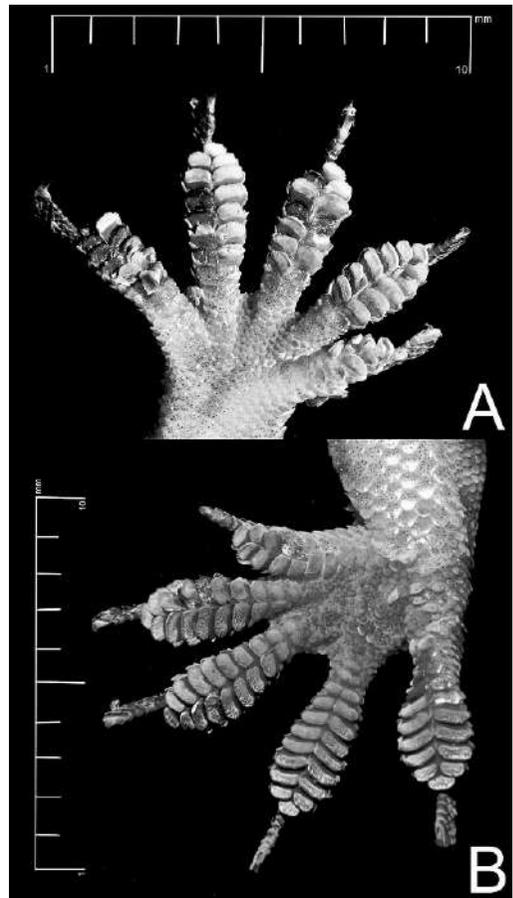


FIG. 4. (A) Ventral view of right manus of *Hemidactylus gujaratensis* sp. nov. holotype, BNHS 1818. (B) Ventral view of right pes of *H. gujaratensis* sp. nov. holotype, BNHS 1818.

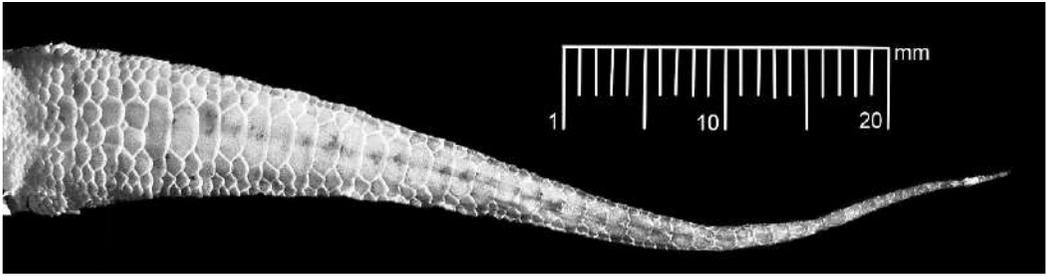


FIG. 5. Tail venter of *Hemidactylus gujaratensis* sp. nov. holotype, BNHS 1818.

distinct, 28–30 scale rows across venter between lowest rows of tubercles. Ten to 11 enlarged scensors beneath fourth digit and 7–9 beneath first digit of both manus and pes. Twelve to 14 femoral pores on each thigh, separated by a median diastema at least five scales in males. Original tail depressed, oval in transverse section, slightly constricted at base, tuberculate with a median dorsal furrow; a single median row of transversely enlarged subcaudal plates. Dorsal pattern with a pale vertebral stripe and eight irregular pairs of alternating light and dark transverse markings.

Among its south Asian congeners (24 occurring in India, plus the endemic Sri Lankan *Hemidactylus depressus* Gray, and *Hemidactylus turcicus* (Linnaeus), and *Hemidactylus robustus* Heyden, both recorded from Pakistan) *H. gujaratensis* may be distinguished from *Hemidactylus gracilis* Blandford, *Hemidactylus reticulatus* Beddome, *Hemidactylus albofasciatus* Grandison and Soman, *Hemidactylus imbricatus* Bauer et al., *Hemidactylus sataraisensis* Giri and Bauer, and *Hemidactylus anamallensis* (Günther) on the basis of its divided subdigital lamellae (vs. lamellae undivided or only distal lamellae divided or notched), from *Hemidactylus scabriceps* Annandale by its juxtaposed (vs. imbricate) dorsal scalation, from *Hemidactylus platyurus* (Schneider) by its lack of a distinct lateral skin flap, from *Hemidactylus frenatus* Duméril and Bibron, *Hemidactylus garnotii* Duméril and Bibron, and *Hemidactylus karenorum* by its longer first digit of the manus (more than half the length of digit II vs. less than half the length of digit II), and from *H. robustus*, *H. persicus*, *H. turcicus*, and *H. porbandarensis* by its greater number of preloacal-femoral pores in males (12–14 on each thigh with a median diastema of five or more scales vs. 13 or fewer preloacal pores in a continuous series and no femoral pores). In the presence of 12–16 rows of irregularly arranged, slightly enlarged, feebly keeled, flattened to weakly conical tubercles *H. gujaratensis* n. sp. differs from *Hemidactylus giganteus* Stoliczka, *Hemidactylus* cf. *bowringii* (Gray), *Hemidactylus flaviviridis* Rüppel, and

Hemidactylus leschenaultii Duméril and Bibron, (tubercles small, few and scattered or absent entirely) and from *Hemidactylus maculatus* Duméril and Bibron, *Hemidactylus depressus*, *Hemidactylus triedrus* Daudin, *Hemidactylus subtriedrus*, *Hemidactylus brookii* Gray, *Hemidactylus prashadi* Smith, and *Hemidactylus mahendrai* (14 or more rows of large, strongly conical, keeled, subtrihedral, or trihedral tubercles).

The new species bears some resemblance to the recently described *Hemidactylus aaronbaueri* Giri but differs (*H. aaronbaueri* vs. *H. gujaratensis*) with respect to maximum size (128 mm vs. 65 mm SVL), dorsal pholidosis (18–20 vs. 12–16 rows of dorsal tubercles), scensors beneath the fourth toe (11–13 vs. 10–11), femoral pores on each side (15–19 vs. 12–14), supraciliary scales (large, mucronate; posterior scales forming short, stout, projecting spines versus small, pointed, those at the anterior end of orbit only slightly enlarged), and coloration (dorsal pattern of five relatively well-defined, dark, transverse, undulating crossbars between occiput and sacrum versus eight clearly demarcated to ill-defined alternating light and dark irregular to straight-edged bands).

Description of the Holotype.—Adult female (Fig. 2) 64.6 mm SVL. Head short (HL/SVL = 0.27), wide (HW/HL = 0.77), not strongly depressed (HH/HL = 0.47), weakly distinct from wide (13.3 mm) neck. Loreal region slightly inflated, canthus rostralis relatively prominent (Fig. 3A). Snout short (SE/HL = 0.44), approximately twice as long as eye diameter (OD/SE = 0.45); scales on snout and canthus rostralis juxtaposed, smooth, weakly conical, approximately twice size of those on forehead; interorbital and occipital region with much smaller, granular scales, of which interorbitals are slightly larger. Eye small (OD/HL = 0.20); pupil vertical with crenulated margins; supraciliaries small, pointed, those at the anterior end of orbit slightly larger. Ear opening oblique, longer (1.7 mm) than broad (0.5); eye to ear distance slightly greater than diameter of eye (EE/OD = 1.60). Rostral wider (2.5 mm) than deep (1.5 mm), deeply notched, divided

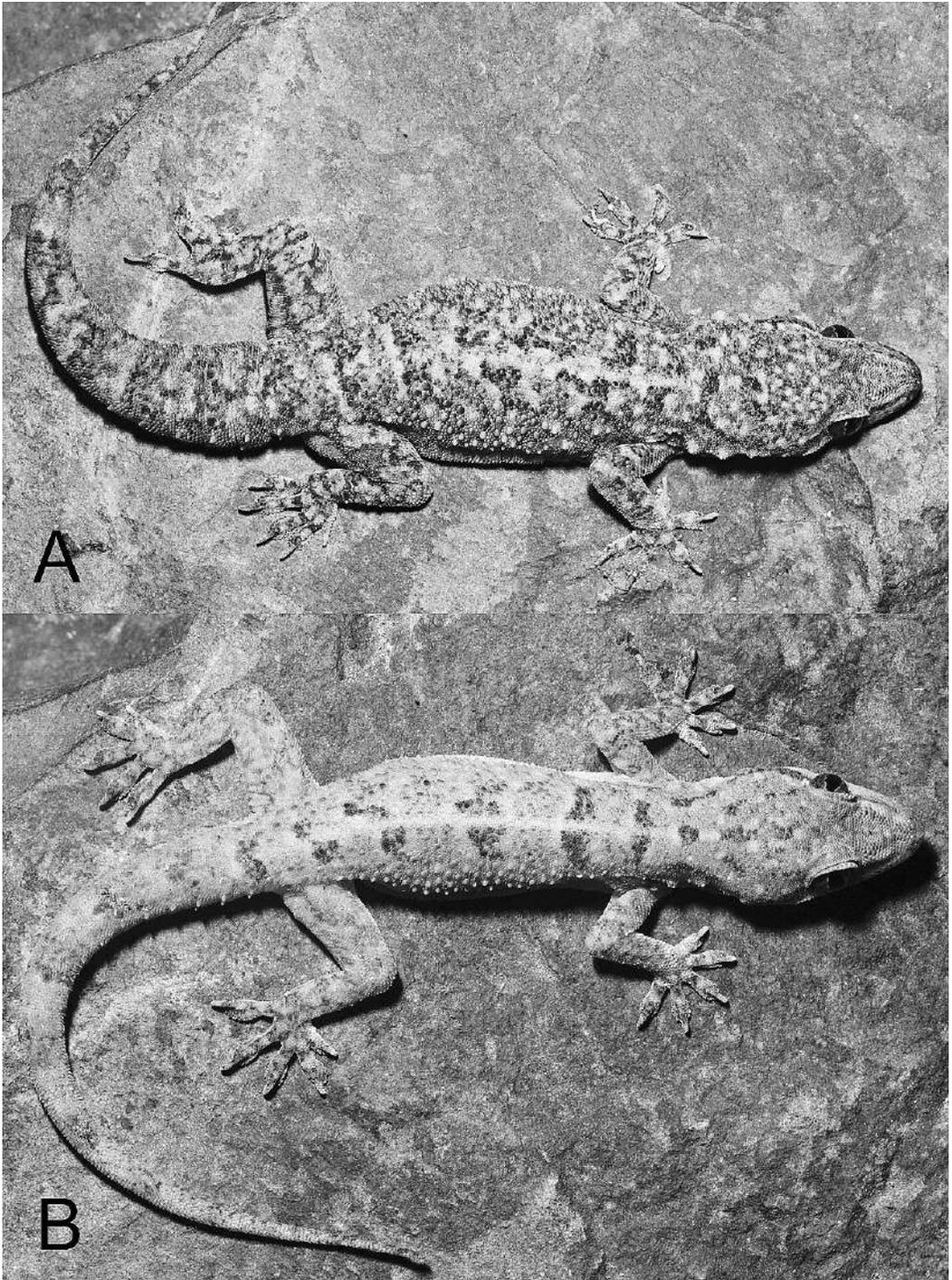


FIG. 6. (A) Holotype (BNHS 1818) of *Hemidactylus gujaratensis* sp. nov. in life. Note the transverse markings, which are nearly completely faded after preservation (compare Fig. 2). (B) Paratype (BNHS 1812, subadult male) of *H. gujaratensis* sp. nov. in life.

middorsally by strongly developed rostral groove, in contact with first supralabial, supranasals, and a single internasal; enlarged, raised supranasals separated by three much smaller, longitudinally arranged internasals; nostrils circular, each surrounded by supranasal, rostral, first supralabial, and two subequal postnasals, each larger than internasal; 2–3 rows of scales separate orbit from supralabials. Mental triangular, two pairs of postmentals, anterior pair larger and touching behind mental, each bordered by mental, first and second infralabials, posterior postmental and four enlarged chin shields; posterior postmentals half the length of anterior pair, bordered by second and third infralabials, anterior postmental, 3–4 enlarged chin shields, and two enlarged scales bordering the infralabials medially (Fig. 3B). Infralabials bordered by 2–3 rows of enlarged scales that grade into granules medially and posteriorly; enlarged scales medial to infralabials 6–9 distinctly imbricate. Supralabials to midorbital position 8 (left and right), to angle of jaw 10 (left and right); infralabials to angle of jaw 8 (left)–9 (right).

Body relatively stout (TRL/SVL = 0.41). Ventrolateral skin folds inconspicuous, without denticulate edges. Dorsal scales heterogeneous, small granules, intermixed with 12–16 irregularly arranged rows of slightly enlarged, flattened to weakly conical tubercles extending from neck to tail; each enlarged tubercle roughly twice to thrice the size of adjacent granules and surrounded by rosette of 8–9 small granules, 2–4 granules between adjacent enlarged tubercles; tubercle size more-or-less uniform except in the two most medial parasagittal rows and in the ventralmost flank row, which are slightly smaller. Ventral scales larger than dorsal, smooth, imbricate, slightly larger on abdomen and preloacal region than on chest; no preloacal or femoral pores present; midbody scale rows across venter to lowest row of tubercles 28–30; gular region with smaller, weakly imbricate scales, rapidly transitioning to smaller, juxtaposed granules under throat (Fig. 3B).

Scales on palms and soles smooth, rounded; scales on dorsal aspect of fore limb subimbricate to imbricate, interspersed with enlarged, weakly keeled tubercles, subequal to those on body dorsum; dorsal scales of hind limbs juxtaposed, heterogeneous, those on posterior surfaces granular, anterior scales much larger, larger than those on dorsum, intermixed with still larger trihedral tubercles. Fore- and hind limbs relatively short, stout; forearm short (FL/SVL = 0.14); tibia short (CL/SVL = 0.16); digits moderately short, strongly clawed; all digits of manus and digits I–IV of pes indistinctly

webbed; terminal phalanx of all digits curved, arising angularly from distal portion of expanded lamellar pad, half or more than half as long as associated pad; all scansors beneath each toe divided except distalmost and some basal to the main pad expansion; scansors (from proximalmost at least twice diameter of palmar scales to distalmost single scansor): 8–9–9–10–9 (right manus; Fig. 4A), 7–10–10–11–10 (right pes; Fig. 4B). Relative length of digits (measurements in mm in parentheses): I (4.28) < II (5.14) < V (5.21) < III (5.33) < IV (5.42) (right manus); I (3.63) < II (5.42) < V (5.85) < III (5.98) < IV (6.25) (right pes).

Tail depressed, flat beneath, verticillate, with well-defined median furrow; length of partly regenerated tail approximately equal to SVL; tail covered above with small (larger than those on the dorsum), posteriorly directed, subimbricate to imbricate, smooth scales and a series of 2 (rarely 3) enlarged, feebly keeled tubercles on either side of the median furrow; ventral scales larger, imbricate, median row greatly enlarged to form subcaudal plates approximately 3–4 times wider than adjacent scales, not extending across width of the tail proximally, but nearly so distally (Fig. 5).

Coloration in Life.—Olive brown background color with a narrow beige vertebral stripe extending from occiput to sacrum (Fig. 6A). Dorsum with a series of eight sets of alternating, narrow, greyish-white and broader dark brown transverse markings between occiput and sacrum. Posteriormost two white bands complete and perpendicular to vertebral stripe; more anterior bands incomplete or irregularly curved. Upper flanks with scattered white tubercles. Parietal region with a transverse series of alternating white and dark brown spots. Crown with numerous small, irregularly distributed white spots on a mottled brown background. Spots faded and more elongate in interorbital area. Canthus bearing a beige stripe bordered ventrally by a thinner brown stripe. A broad brown stripe with a well-defined dorsal margin and diffuse ventral margin and bordered above and below by bold white spots extending from posterior rim of orbit and forming, with the brown occipital cross-band, an incomplete nuchal band. Iris coppery-brown.

Forelimbs irregularly banded with whitish markings on a mottled brown background, banding continuing on to digits. Hind limbs similar but with banding evident only on shanks and pedes. Thighs with dark-edged pale blotches oriented along the limb axis.

Tail coloration similar to dorsum, mottled olive brown background with scattered darker brown markings and a series of faint, narrow, irregular, transverse white bands. Pale bands

TABLE 1. Mensural data and subdigital lamellar counts for holotype and paratypes of *Hemidactylus gujaratensis* sp. nov. Abbreviations as in Materials and Methods. All measurements in millimeters.

	Holotype		Paratypes			
	BNHS 1818	BNHS 1812	BNHS 1813	BNHS 1814	BNHS 1815	
Sex	♀	♂	♀	♀	♂	
SVL	64.6	48.1	58.6	62.2	52.5	
TRL	26.6	19.9	25.5	26.1	21.2	
BW	18.5	10.4	13.6	14.8	13.1	
CL	10.1	7.8	9.4	9.8	8.7	
TL	65.1	—	63.3	65.1	56.3	
TW	9.9	—	6.9	9.2	6.6	
HL	17.8	14.6	16.4	17.2	15.6	
HW	13.4	10.0	11.8	12.2	11.0	
HH	8.4	5.8	6.6	7.1	6.3	
FL	9.1	6.8	8.2	8.3	7.6	
OD	3.6	3.0	3.4	3.4	3.2	
NE	6.3	4.9	5.8	6.0	5.5	
SE	7.9	6.5	7.4	7.6	6.8	
EE	5.7	4.7	4.5	4.5	4.8	
EL	2.0	1.6	1.8	1.7	1.4	
IN	1.7	1.4	1.7	1.8	1.6	
IO	5.0	4.1	4.8	5.2	4.6	
Lamellae						
L Manus	8-9-9-10-10	9-9-10-10-10	9-10-10-10-10	9-9-10-11-10	9-9-9-10-10	
R Manus	8-9-9-10-9	8-9-9-10-10	9-10-9-10-10	9-10-9-10-9	9-9-10-10-10	
L Pes	7-10-10-11-10	7-10-10-11-10	8-10-11-10-10	7-10-10-11-9	8-10-10-10-11	
R Pes	7-10-10-11-10	7-10-11-12-10	8-10-11-10-9	8-10-10-11-10	8-10-10-10-11	

becoming wider on distal portion of tail, 10 such bands on postpygal portion of tail in holotype. Venter white with suffusion of dark speckling on margins of neck and limbs. Dorsal coloration of tail continuing on to venter and stopping abruptly at margin of enlarged midventral plates. Scarred areas on left shoulder, right thigh, and on trunk purplish.

Variation.—Mensural data and subdigital lamellar counts for the type series are given in Table 1. All paratypes resemble the holotype except as follows: 2 internasals (all paratypes); 8 supralabials in all paratypes except BNHS 1813; 8 infralabials in all paratypes except BNHS 1815 (9); 26–28 midbody scale rows across venter in BMHS 1815; 12 femoral pores on each thigh, with a median diastema of five scales, in subadult male BNHS 1812, 14 femoral pores on each thigh, with a median diastema of four scales, in larger male paratype BNHS 1815. Color pattern of paratypes similar, although variable in boldness (Fig. 6B). In preservative the vertebral stripe remains apparent but the transverse body markings and tail bands are faded (Fig. 2).

Distribution.—At present *H. gujaratensis* is only known from the type locality (Fig. 1), a well-known religious site and tourist destination in the Girnar Hills, Junagadh District, Gujarat, India. The Girnar Hills (100–1,100 m

asl) constitute the largest hill complex on the Saurashtra Peninsula. This region falls in the semiarid zone (Champion and Seth, 1968), and its vegetation is characterized as dry mixed deciduous teak forest (Barqi, 2000). The surrounding forest of Girnar is one of the prime habitats of the remaining population of Asiatic Lion (*Panthera leo*).

The particular forest pocket in which *H. gujaratensis* was collected is disturbed and is dominated by Palash (*Butea monosperma*), Karanj (*Pongamia pinnata*), Bor (*Zizyphus mauritiana*), Umro (*Ficus racemosa*), Vad (*Ficus bengalensis*), Amlī (*Tamarindus indica*), Deshi Baval (*Acacia nilotica*), and Teak (*Tectona grandis*), along with *Euphorbia* clumps and invasive Vilayati Babul (*Prosopis chilensis*) and Gandhari (*Lantana camara*). The area falls within a forest reserve and is one of the most important habitat corridors between Barda Wildlife Sanctuary (in the west) and Gir National Park and Sanctuary (in the southeast). We suspect that the species may be more widely distributed through these large contiguous forest tracts.

Natural History.—The type specimens were captured on a temple wall consisting mainly of loose boulders. This temple is located on one of the lower elevation hills (179 m), near a small perennial stream, and is surrounded by trees, bushes, and large boulders (Fig. 7). All the

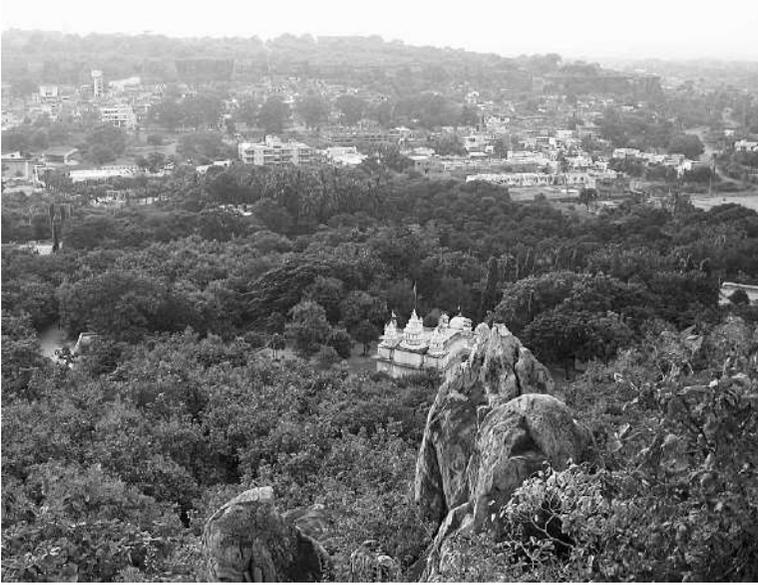


FIG. 7. Type locality of *Hemidactylus gujaratensis* sp. nov. in disturbed forest at low elevation in the Girnar Hills, Gujarat. Note the temple at center and the proximity of the site to the adjacent city of Junagadh.

specimens were caught at approximately 1930 h.

Hemidactylus gujaratensis are mostly nocturnal and emerge from their diurnal retreats in the evening. A total of 22 specimens was counted in approximately 1,000 m² in a span of two hours. Although chiefly active on boulders, two specimens were seen on the ground and one on a tree trunk, which it climbed when disturbed. Two specimens were also observed basking during the day on large boulders. At the type locality, the species is sympatric with two congeners, *H. brookii* and *H. flaviviridis*.

DISCUSSION

Despite its ubiquity, *Hemidactylus* is one of the most poorly studied groups of reptiles in India; although preliminary phylogenetic studies of the genus have been conducted (Carranza and Arnold, 2006; Bauer et al., 2008), relationships among most south Asian taxa remain unresolved. However, the relatively stout body and features of digital morphology suggest that *H. gujaratensis* is a member of a chiefly rock-dwelling (and, to a lesser extent, arboreal) group of Indian *Hemidactylus* that also includes *H. giganteus*, *H. maculatus*, *H. prashadi*, *H. aaronbaueri*, *H. flaviviridis*, and *H. leschenaultii*, all of which are partly or mostly associated with rocky habitats (Giri et al., 2003b; Giri and Bauer, 2006; Giri, 2008; pers. obs.). Among these taxa *H. gujaratensis* is phenetically most similar to *H. aaronbaueri* in some regards, but in the absence

of a well-corroborated species level phylogeny for Indian geckos, it is not presently possible to determine whether this resemblance reflects genealogy.

Except for a few survey reports, the forests of Gujarat are herpetologically unexplored. Most of the major mountain ranges of peninsular India, such as the Western Ghats, Satpura, Aravalli and Vindhya ranges have a terminus in Gujarat. The varied geology and topography of these upland areas, coupled with the extensive xeric regions that are contiguous with those of Rajasthan and Pakistan, result in high habitat diversity, which, in turn, supports a unique and diverse biota. In view of both the disturbed habitat in which *H. gujaratensis* sp. nov. was discovered and other recent additions to the saurian fauna of India, many also from disturbed habitats or based on old museum material (Mukherjee et al., 2005; Vyas et al., 2006; Manamendra-Arachchi et al., 2007; Giri, 2008; Giri and Bauer, 2008), it is likely that poorly documented and minimally disturbed regions of Gujarat may yield additional herpetological discoveries. Further, additional research in the Girnar hills will be necessary to document the extent of occurrence of *H. gujaratensis* and to assess its conservation status. The large influx of tourists represents a growing anthropogenic pressure on the type locality. To mitigate associated threats, proper conservation measures should be taken to protect the habitat of this species at the type locality and in other potential habitats.

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