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A New Angular-Toed Gecko From Pakistan, With Remarks on the Taxonomy and A Key to the Species Belonging to Genus *Cyrtodactylus* (Reptilia: Sauria: Geckkonidae)

M.S. KHAN
Herp Laboratory, 15/6 Darul Saddar North, Rabwah-35460, Pakistan

Abstract.- A new gecko, belonging to southeast Asian cyrodactylid stock of geckos collected from Batgram, District Mansehra, NWFP, Pakistan, is described. It is compared with other geckos known from circum-Himalayan region. Observations on its habitat and ecology are recorded. Taxonomy and distribution of Pakistani cyrtodactylid geckos are discussed.

Key words: Reptilia, Sauria, Lacertalia, Gekkonidae, *Cyrtodactylus* new species, taxonomy.

INTRODUCTION

During May 1989, the author collected a series of seven angular-toed geckos from Batgram, District Mansehra, NWFP, Pakistan. On laboratory study, these geckos proved to belong to a new species. The following description pertains to the new species.

Cyrtodactylus battalensis, new species
(Fig. 1)

Holotype

BMNH 1990.2 (MSK 0764.89), adult male, collected from under a bridge on Karakoram Highway, near Batgram Town, District Mansehra, NWFP, Pakistan, 34°40′N, 73°03′E, elevation 800 m, M.S. Khan, 24 May, 1989.

Paratypes

Six topotypes with the same data as for the holotype, except as noted: SR 3046:20252 (MSK 0737.89) an adult male; NMW 31720 (MSK 0762.89), a young male; CAS 170533 (MSK 0766.89) an adult female; USNM 284135 (MSK 0767.89) a gravid female with an egg in each oviduct; FMNH 235534 (MSK 0765.89) an adult male; MSK 0763.89, a juvenile.

Abbreviations used

BMNH, British Museum (N.H.), London; CAS, California Academy of Sciences, San Francisco; FMNH, Field Museum of Natural History, Chicago; MSK, Herp Laboratory, Rabwah-35460, Pakistan; NMW, Naturhistorisches Museum, Wein, Austria; Sr, Institute of Zoology, Academy of Sciences, Kiev-30, Ukrain; USNM, National Museum of Natural History, Washington, D.C., USA.

Diagnosis

A large species of *Cyrtodactylus* geckos, with dorsal granular scales of body interspersed with scattered obtusely keeled flattish "tubercles"; 50-52 scales across midabdomen; 199-205 scales along the midventrum of body, from postmental to anterior of vent; 9-10 preanal pores arranged in an arch, no femoral pores; tail without marked segmentation, with two rows of small rounded caudal keelless tubercles well marked in anterior half of the tail, on each dorsolateral side; subcaudals small in several rows.

The new species *Cyrtodactylus battalensis* (Fig. 1) is closest in body form and pholidosis to the circum-Himalayan stock of southeast Asian cyrtodactylid geckos; *C. tibetinus, C. mintoni* and *C. dattanensis*. However, *C. battalensis* has relatively longer body and tail, a wider range of supralabials, interorbitals, scales across midabdomen and along body midventrum (Table I). The dorsal pattern of body has very irregular dark transverse bands, narrower than the interspaces, forming a reticulation by the union of irregular borders of the bands with each other. However, *C. dattanensis* comes closer to the new species is number of interorbitals, and scales the midabdomen. *C. dattanensis* and *C. tibetinus* both have a banded dorsal pattern, but the bands are broader than the interspaces, while in *C. mintoni* they are much narrower than the interspaces as in *C. battalensis* but are broken in spots on the sides instead of forming a reticulum.

Description of holotype

Habitus moderately robust, body and tail cylindrical and plump. Nostrils lined by rostral, a post rostral, first supralabial and a pair of nasal scale;

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Fig. 1. *Cyrtodactylus battalensis*, new species holotype. BMNH 1990.2 (MSK 0767.89), dorsal pattern.

postrostral paired, each as broad as seventh supralabial and mesially in contact with its partner. Interorbital scales 28-30 in a lines; a patch of 4-5 large tuberculated scales in the preorbital region. A distinct frontal and a preorbital depression on each side; nasal part of the loreal region vertical; naris lateral, not visible from dorsal view. Ear opening oval much large than a dorsal tubercle. A double row of smooth superciliary scales. Supralabials 9/1, infralabials 8/9. Dorsal tubercles round, conical, those on lateral and posterior sides, broad with obtuse keels, separated from each other by 4-5 granular scales. Dorsal tubercles irregularly arranged, roughly in 12-13 transverse and 22-23 paravertebral rows. They are round, conical, those on lateral and posterior sides broad with obtuse keels, separated from each other by 4-5 granular scales.

Mental scale triangular; two pairs of postmentals, first largest, broadly in contact with each other, suture between them longer than the mental scale. Abdominal scales slightly imbricate, 50-52 across midabdomen; lateral scales almost indistinct from abdominals; 194-198 scales along midventrum of the body, from postmental suture to anterior of vent. Nine angularly arranged preanal pores. Five transverse rows of large scales between preanal pores and anterior lip of vent. Subfemoral scales smaller than abdominals, slightly imbricate. Postanal pockets distinct, a pair of lateral anal tubercles present at the base of the tail on each side.

Limbs medium sized, when stretched forwards, tips of finger claws touch border of eye, those of toes hardly the elbow. Digits small, fourth finger with 16/14 and fourth toe with 20/21 subdigital lamellae, lamellae as broad as the digit, slightly imbricate, those at the angles of the digits swollen. Upper arm with imbricate scales in longitudinal rows, those on forearm heterogeneous interspersed with tubercular scales. Thigh and tibia with slightly imbricate scales interspersed with few fine-tipped tubercles; subfemoral scales small, in regular transverse rows.

Tail round in cross section, segmentation indicated by a transverse row of four blunt-tipped, obtusely keeled caudal tubercles, a pair on each dorsolateral side of the tail. Caudal tubercles are quite apart from each other. Subcaudals small, those at midtail distinct from others, longer than broad. Tail fragile at any point along its length, tail of holotype broken at two points.

Colour

In life dorsum of the new species is light brown, with seven transverse dark brown bands, much thinner than interspaces. Each band with very irregular anterior and posterior margins, which at places touch similar irregularities of adjacent bands to form a distinct dorsal dark reticulum extending on to the sides of the body. A vivid dark stripe from the side of the snout through loreaum, eye and joins the first transverse band of the dorsal reticulum. Frontal region of the head with a dark U-shaped mark and several transverse spots on head top and interorbital space. Limbs dorsum with dark reticulation.

Tail with eleven dark rings, extending on the tail ventrum.

Table 1.- Pholidosis and measurements (in mm) of *Cyrtodactylus battalensis*, new species.

Character	1	2	3	4	5	6	7
Sex	m	m	f	m	m	m	j
Snout vent length	63.3	58.1	72.3	61.5	67.4	53.1	38.7
Tail length	63.9	58.2	55.5+	42.5+	50.0+	41.8+	35.4
Supralabials	9/10	10	12/11	10	11/10	9/11	10/11
Interorbitals	30	27	26	25	29	27	26
Dorsal tubercles							
midbody transverse approx. count	13	12	14	12	14	14	13
Paravertebral longitudinal count	23	22	27	24	30	28	27
Subdigital lamellae							
under fourth finger	16	18	18	16	16	17	16
under fourth toe	21	20	21	19	18	19	18
Midventral counts	198	199	201	203	198	205	200
scales across midabdomen	52	50	60	51	51	56	57
Preanal pores	9	8	8	8	10	10	0

f, female; j, juvenile; m, male. +, regenerated. 1, BMNH 1990.2, holotype. Type series: 2, SR 3046:20252; 3, USNM 284135; 4, FMNH 235534; 5, CAS 170533; 6, NMW 31720; 7, MSK 0763.89.

Measurements (in mm)

Total length 127.2; snout-vent length (SVL) 63.3; head length 12.4; head width 13.8; head height 6.7; snout length 6.9; diameter of eye (not including bony ring) 3.9; vertical diameter of ear opening 1.6; length of body between axilla and groin 27.2; length of a median dorsal tubercle 0.55.

Etymology

The specific name of the new species "battalensis" refers to the main mountain system of the area, known as the Battal Range in which the type locality is situated.

Variations

Table II quantifies morphological variations in the type series of the new species. The only adult female in the series, USNM 284135, is longer in SVL (72.3) than the longest male CAS 170525. The geckos vary markedly in dorsal pattern. Basically seven dark brown transverse bands are present from nape to the level of vent, a pattern also present in the juvenile MSK 0767.89. In adult animals the anterior and posterior borders of bands are irregular and touch those of anterior as well posterior successive bands giving rise to a dorsal reticulation. The type series consists of five males, one female and a juvenile. Males differ from females in having preanal pores. SR 3046:20252 has eight preanal pores, while BMNH 1990.2 and FMNH 235533 have nine each, and CAS 170525 and NMW 31720 both have 10 preanal pores. USNM 284135, a female has eight slight depressions at the site of the preanal pores, while there is no indication in juvenile MSK 0767.89.

Habits

The type locality of the new species, Batgram, is a small hilly town, elevation 800 m, 103 km N of Abbottabad. A deep torrent drains the area into the River Indus, 15 kw W. On the south of the Battal Range lies the vast fertile Chatter Plain. Natural vegetation consists of long grasses and low bushes growing among broken rocks, with pines on the mountain tops. Seasonal crops are sown where ever flat land is available in the narrow valleys.

The bridge, from under which the new species was picked, is flanked by a growth of long grass. At the time of collection the geckos were coming out of holes and crevices under the roof of the bridge. Some had already descended to the floor of the bridge. Other geckos

Table II.- **Comparison of *Cyrtodactylus battalensis* sp. nov., with its congeners so for reported from Pakistan (data for *C. mintoni* from literature).**

Character	*C. battalensis*	*C. mintoni*	*C. dattanensis*
No. of specimens	7	1	10
Snout vent length	38-72	38.4	52-62
Caudal length	35-72	45	33-57
Supralabials	9/11	11	9-10
Infralabials	8/10	9/8	7/9
Interorbitals	25-32	30	21-35
Scales:			
midabdomen	50-54	36	47-56
midventrum	198-205	150	149-187
Subdigital lamellae			
under 4th tow	18-21	17	14-16
Preanal pores	8-10	0 (female, probably 9)	9-10
Dorsal transverse			
narrow than inter-spaces	+	+	-
broader than inter-space	-	-	+
with irregular margins	+	-	-
Dorsal pattern	reticulum	banded, spotty on sides	banded

+, regenerated.

collected from the nearby houses on the sides of the bridge were *Hemidactylus brooki* and *H. flaviviridis*, while from nearby rocks *Agama agrorensis* were picked. Along the bank of the torrent below, *Bufo stomaticus, B. melanostictus*, and *Rana limnocharis, R. cyanophlyctis, Microhyla ornata* and *Xenochrophis piscator* were collected. Other snakes collected from the area were *Ptyas mucosus, Bungarus caeruleus*, and *Spalerosophis diadema*.

During Eocene the collision of the Indian Plate into the Asian main landmass, resulted in the uplift of five series of ranges of greater Himalayas (Buffetaut and Ingavat, 1985). Several small oceanic volcanic islands which were lying between the two land-masses were crushed in the process (Jaeger *et al.*, 1989), and are now represented by a complex crumpled mountained system, lying in the south of Himalayas know as Indus-Kohistan Ranges with a northward tilt (Khan *et al.*, 1979; Powal, 1979; Khan, 1980b; Adamson and Shaw, 1986). These mountain ranges have been invaded by southeast Asian species relatively recently. Apart from *Cyrtodactylus battalensis, Bufo melanostictus, Ptyas mucosus* are southeast Asian elements found here.

TAXONOMIC REMARKS

The subfamily Geckkoninae is a large heterogeneous assemblage of species, with a complex evolutionary history (Kluge, 1967, 1983; Szczerbak and Golubev, 1984, 1986). Underwood (1954) placed angular-toed geckos in two genera, restricting South American geckos to the genus *Gymnodactylus* Spix, 1885, and all the Southeast Asian, Indonesian and Australian species in the genus *Cyrtodactylus* Gray, 1827. Heterogenosity of cyrtodactylid geckos was further sorted out recently by Szczerbak and Golubev (1984, 1986). They distinguished them in three genera:

Genus *Tenuidactylus* Szczerbak and Globev, 1986 have geckos with Palearctic affinities. They have trihedral keeled tubercles on body dorsum, arranged in longitudinal rows; toes long and compressed with narrow subdigital lamellae; three pairs of submental scales; caudal tubercles trihedral strongly keeled tend to touch each other on sides; subcaudals broader than long, two to a caudal segment; tail distinctly segmented; both preanal and femoral pores present and are arranged in a series. This genus is represented in Pakistan by two species: *T. montiumsalsorum* (Annandale, 1913; Khan, 1989) and *T. kohsulaimanai* Khan, 1991).

Genus *Cyrtopodion* Fitzinger, 1843 is resurrected to include geckos with Palearctic affinities, essentially similar to *Tenuidactylus* geckos, differing in having only preanal pores and more separated and smaller subtrihedral dorsal tubercles. Pakistani species included in this genus are *C. kachhensis* (Stoliczka, 1822), *C. scaber* (Heyden, 1827) and *C. watsoni* (Murray, 1892). Szczerbak and Golubev (1986) have placed *T. montiumsalsorum* in this genus, while Khan (1989) has shifted it to genus *Tenuidactylus*.

Genus *Cyrtodactylus* is oriental and it is characterized by short toes with broad subdigital lamellae; round and slightly keeled dorsal tubercles; homogeneous head scales; 1-2 pairs of submental scales; small round caudal tubercles, indistinct and homogeneous subcaudal scales and has only preanal pores. This genus includes circum-Himalayan Geckos like *C. tibetinus* (Boulenger, 1905), *C. mintoni* Golubev and Szczerbak, 1981, *C. fasciolatus* (Blyth, 1860), *C.*

lawderanus (Stoliczka, 1871), *C. himalayanus* Duda and Sahi, 1978, and *C. dattanensis* (Khan, 1980b). In the southeast Asia there are several cyrtodactylid species which do not fall in the range of our present study.

So far five species of genus *Cyrtodactylus* (senso lato) are known from circum-Himalayan region: *C. fasciolatus* (Blyth, 1860) from Subathu, Simla District, India; *C. tibetinus* (Boulenger, 1905) from Chaksam Ferry, Tasanngopo Valley, Tibet; *C. himalayanus* Duda and Sahi, 1979, from Jamu, Kashmir; *C. dattanensis* (Khan, 1980a) from Datta, Manshera, NWFP, Pakistan; and *C. mintoni* (Golubev and Szczerbak, 1981), from Undigram, Swat, NWFP, Pakistan. The new species adds sixth to the cyrtodactylid species of circum-Himalayan region.

Discussion

Tenuidactylus and *Cyrtopodion* geckos recorded from Pakistan differ from the new species *Cyrtodactylus battalensis* in important morphological characters: body and tail are dorsoventrally depressed, tail longer than body and strongly segmented; three rows of large trihedral caudal tubercles on each side of the tail, body dorsum with rows of similar tubercles; subcaudals much broader than long; 21-40 scales across midabdomen; 9-19 interorbital scales; 100-169 midventral scales; preanal and femoral pores present in a continuous series in *Tenuidactylus*, while only preanal pores are present in genus *Cyrtopodion*.

Recently described sandstone geckos *Tenuidactylus indusoani* (Khan, 1988) and *T. rohtasfortai* Khan and Tasnim, 1990, differ from the new geckos in having much depressed body and tail, tail is longer than body, with strong segmentation and trihedral large caudal tubercles; subcaudals are transversely enlarged; fewer interorbitals (13-16), scales across midabdomen (21-23); midventral scales (103-135). However, high altitude geckos *Gymnodactylus stoliczkai* Steindachner, 1868; *Cyrtodactylus yarkandensis* J. Anderson, 1872 and *Gymnodactylus walli* Ingoldby, 1922 (= *Gymnodactylus chitralensis* Smith, 1935), differ from the new species due to their depressed tail and body, however caudal tubercles and subcaudals are similar, but the caudal tubercles arise from the middle of the tail segments. Moreover, both preanal and femoral pores are absent in *G. stoliczkai* and *C. yarkandensis*, while preanal pores are present in *G. walli*.

Szczerbak and Golubev (1986) have included *G. stoliczkai* and *G. walli* in genus *Cyrtodactylus* which due to above stated differences is not justified.

The cyrtodactylid geckos of circum-Himalayan region are distinguished from all other geckos of the region on the basis of following set of characters:

1. Plump body and tail, which are subequal in length.
2. Dorsal body tubercles are small, conical or oval, weakly keeled, much smaller than interspaces.
3. Two pairs of postmentals, first pair in contact with each other, length of the suture equals the length of mental scale.
4. Interorbital scales 25-50.
5. Supraciliaries in double row weakly pointed.
6. Tail not distinctly segmented.
7. Subdigital lamellae broad and imbricate.
8. Subfemoral scales smaller than abdominals, arranged roughly in transverse rows.
9. No post and subfemoral tubercles.
10. A pair of postanal pockets distinct with openings.
11. A vivid pattern of spots, transverse bands or reticulation on body dorsum.
12. Transverse bands on tail extend on tail ventrum.

The new species *Cyrtodactylus battalensis* is distinguished from its congeners, reported from circum-Himalayan region, by the following key:

1. Subcaudals broader than long; a transverse row of enlarged subfemoral scales ..... *C. fasciolatus*
   Subcaudals not broad; no enlarged subfemoral scales 2
2. Dorsal pattern of spots and irregular lines 3
   Dorsal pattern of transverse bands 4
3. Body and limbs without tubercles; tail depressed, shorter than body ..... *C. laderanus*
   Tubercles on body and limbs; tail round, longer than body ..... *C. himalayanus*
4. Dorsal bands broader than interspaces 5
   Dorsal stripes narrower than interspaces 6
5. Midventrals 85-106; 21 subdigital lamellae under fourth toe ..... *C. tibetinus*
   Midventrals 149-162; 14-17 subdigital lamellae under fourth toe ..... *C. dattanensis*
6. Dorsal stripes narrow, tend to break in isolated dark spots on the side of the body ..... *C. mintoni*
   Dorsal stripe pattern breaks into distinct dorsal dark reticulum; a pair of nasal scales ..... *C. battalensis*

Cyrtodactylus fasciolatus (Blyth, 1860) shares many characters with geckos of genus *Tenuidactylus*: three pairs of submentals, a series of broad subcaudals, tail longer than body, presence of tubercular scales on thigh and shank, longer limbs and digits and narrow subdigital lamellae. However, there is ambiguity in literature regarding presence of preanal and femoral pores in this species: Annandale (1913:313) records 10-12 preanal

pores and no femoral pores in male, while Smith (1935:46) records a continuous series of 15 or 16 preanal and femoral pores on each side of a female of this species. Apparently later author has confused the sex of the specimen. BMNH 1913.11.11.2, is an adult *C. fasciolatus* (SVL 54.1, caudal length 74.5), it has neither preanal nor femoral pores, apparently a female.

DISTRIBUTION OF CIRCUM-HIMALAYAN CYRTODACTYLID GECKOS IN PAKISTAN

Minton (1966) reported *Cyrtodactylus mintoni* from Udigram, Swat, NWFP, 33°08′N, 72°21′E, elevation 8,680 m. *C. dattanensis* was described from Datta, Mansehra, 34°18′N, 73°11′E, elevation 1,180 m (Khan, 1980a). Later Khan and Tasnim (1990) have shown that *C. dattanensis* has much wider distribution, from 33°08′ to 34°18′N, 73°11′ to 74′E, extending between elevation 654 to 1,315 m (see Khan, 1989 for correction of distribution map Fig. 89 in Szczerbak and Golubev, 1986: 200). New species *C. battalensis* is the third collected within the bounds of Pakistan from 34°40′N, 73°03′E, elevation 8,000 m (Fig. 2).

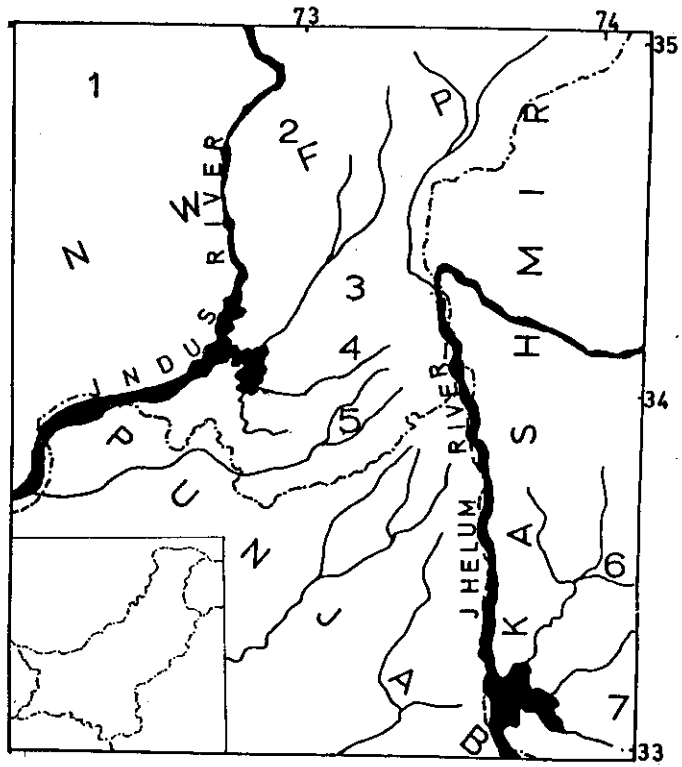

Fig. 2. Northern Pakistan, type localities and distribution of circum-Himalayan cyrtodactylid geckos: 1, Udigram (Swat, NWFP), type locality of *Cyrtodactylus mintoni* (Minton, 1966); 2, Batgram (Mansehra, NWFP), type locality of *C. battalensis* sp. nov.; 3, Datta (Mansehra, NWFP), type locality of *C. dattanensis* (Khan, 1980a), additional localities; 4, Abbotabad (NWFP), 5, Karor (Rawalpindi, Punjab); 6, Goi Madan (Kotli, Azad Kashmir); 7, Chauki (Mirpur, Azad Kashmir); inset: Pakistan, showing the position of the area enlarged in Fig. 2.

APPENDIX I

Additional material examined

Cyrtodactylus collegalensis BMNH 82.4.14.28-29; *C. fasciolatus* BMNH 1913.11.11.2; *C. nebulosus* BMNH 82.4.14.32-33; *C. oldhami* BMNH 1916.6.22.4; *c. pulchellus* BMNH 1916.3.27.1-2; *C. triedrus* BMNH 68.3.17.11-12; *C. dattanensis* MSK 0056.78; *Gymnodactylus walli* BMNH 1910.7.12.1; *G. chitralensis* BMNH 1946.8.23.19; *Cyrtodactylus yarkandensis* BMNH 72.3.22.4; *Tenuidactylus longipes* CAS 115944, SR 307:3267-68; *T. longipes voraginosus* CAS 130323; *T. montiumsalsorum* BMNH 1904.11.19.1 and MSK 014.86; *T. indusoani* MSK 0467.86; *T. rohtasfortai* USNM 284133; *Gymnodactylus stoliczkai* (photograph) NMW 16756; *Tenuidactylus fedtschenkoi* SR 1078:8837-8; *T. caspius* SR 2546:16713-14; *T. turcmenicus* SR 961:8016-17.

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