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Taxonomic notes on angular-toed gekkota of Pakistan, with description of a new species of genus *Cyrtopodion*

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Abstract: Angular-toed gekkos of Pakistan are reassigned to genera which have been proposed by Szczerbak and Golubev, 1996; Szczerbak, 1998. A new *Cyrtopodion* species is described from Potohar Plateau, Salt Range, Pakistan.

Running title: Gekkos of Pakistan.

Key words: Angular-toed gekkos, generic reassignment, new gekko description.

INTRODUCTION

Palearctic angular-toed gekkos were for long placed in Spix's (1825) genus *Gymnodactylus* (Boulenger, 1890; Annandale, 1913; Smith, 1935). Until Underwood (1954) restricted genus *Gymnodactylus* to the South American gekkos and placed south

Asian forms in genus *Cyrtodactylus* Gray 1827, he was followed by subsequent workers (Minton, 1966; Khan, 1980a; Khan and Mirza, 1977). However, Mertens (1969) retained genus *Gymnodactylus* for Palearctic forms placing Pakistani gekkos in subgenus *Cyrtodactylus*.

Szczerbak and Golubev (1984, 1986) erected a new genus *Tenuidactylus* for angular-thin-toed gekkos and divided it in four subgenera to include Palearctic and southeast Asian species: in subgenus *Tenuidactylus* Central Asian and Trans-Caucasian species: *T. caspius* (Eichwald), *T. fedtschenkoi* (Strauch); *T. longipes* (Nikolsky) and *T. turcmenicus* (Szczerbak), were included. While in subgenus *Mediodactylus* gekkos of circum-Mediterranian Region: *T. kotschyi* (Steindachner), *T. amictopholis* (Hoofin); *T. heterocercus* (Blanford); *T. russowi* (Strauch), *T. sagittifer* (Nikolsky), and *T. spinicauda* (Nikolsky), were placed. Third subgenus *Mesodactylus* included southwest Asian species: *T. kachhensis* (Stoliczka), *T. agamuroides* (Nikolsky), *T. elongatus* (Blanford), *T. montiumsalsorum* (Annandale), *T. scaber* (Heyden) and *T. watsoni* (Murray). In subgenus *Cyrtodactylus* Tibeto-Himalayan gekkos *T. stoliczkai* (Steindachner), *T. chitralensis* (Smith), *T. tibetinus* (Boulenger), *T. mintoni* (Golubev and Szczerbak), *T. kirmanensis* (Nikolsky), *T. lawderranus* (Stoliczka) and *T. himalayanus* (Duda and Sahi), were placed.

Later, Szczerbak (1988) raised the status of these subgenera to full-fledged genera.

Present author (1992) found difficult to fit Pakistani species of angular-toed gekkos in Szczerbak and Golubev (1986) and Szczerbak (1988) scenario, for which following generic reassignment is proposed.

Generic reassignment

Khan (in press) distinguished southeast Asian angular-toed gekkos in three groups on the basis of external morphology:

1. CIRCUM-OCEANIC GROUP: Circum-tropical, scattered along sub-continental coastal strips and oceanic islands, between 27-32^{o}N and 75-105^{o} E; dorsal pattern of vivid cross bars or spots; dorsal granular scales mixed with larger rounded, smooth or slightly keeled tubercles; tail and body cylindrical, tail often longer than body. Species included are all extralimital southeast Asian: *Cyrtodactylus pulchellus, C. intermedius, C. consobrinoides, C. frenatus, C. condorensis, C. oldhami, C. peguensis, C. irregularis, C. angularis, C. khasiensis, C. rubidus, C. triedrus, C. nebulosus, C. collegalensis, C. dekkanensis, C. albofasciatus* and *C. jayporensis* (Smith, 1935). For recent group of Philippine cyrtodactylid species see Inger (1957).

2. CIRCUM-HIMALAYAN GROUP: Subtropical, highland forms, mainly extending between 34-40^{o} N and 75-80^{o} E, dorsal granular scales tubercular, bead-shaped, interspersed with 2-3 times larger oval keeled or keelless tubercles arranged in more or less 12-13 longitudinal rows at midbody; body and tail subequal and subcylindrical; subcaudals small in several rows; inconspicuous dorsal pattern of transverse bands, spots or reticulations.

The circum-Himalayan group is further distinguished in three subgroups:

STOLICZKAI* SUBGROUP, GENUS *MESODACTYLUS: body and tail rather flat; caudal tubercles feeble, flat, smooth; anterior half of the tail segmented, segments indicated by lateral lobulation, regenerated tail flattened and abnormally swollen, caudal tubercles

feeble, subcaudals small, no preanal and femoral pores. Dorsal pattern of inconspicuous bands. Includes highland species: One Pakistani representative *Mesodactylus baturensis.* Extralimital species included are: *C. stoliczkai* and *C. yarkendensis.*

TIBETINUS* SUBGROUP, GENUS *CYRTODACTYLUS: Body and tail round; tail segments indistinct; caudal tubercles feebly keeled, regenerated tail neither flattened nor swollen; 4-10 preanal pores. Dorsal pattern of vivid cross bars, spots or reticulations. Includes Tibeto-Himalayan low altitude submountain gekkos: *Cyrtodactylus mintoni, C. dattanensis* and *C. battalensis;* extralimital: *Cyrtodactylus tibetinus* and *C. himalayanus*.

***WALLI SUBGROUP*:** Body flatter; tail quadrangular in cross section, distinctly segmented; caudal tubercles larger slightly keeled; median row of subcaudals transversally enlarged; inconspicuous dorsal banded pattern; 4-6 preanal pores. Species included are: *Cyrtodactylus walli* (=*chitralensis*) and C. *kirmanensis* (extralimital).

3. PALEARCTIC GROUP: characterized by dorsoventrally depressed body and tail, which is longer than body; dorsum with large trihedral tubercles; large flat, sharply keeled caudal tubercles arranged in three latero-dorsal rows on each side; subcaudals in a single row of broader than long scales. The Palearctic group is further distinguished in following two subgroups:

GROUND GEKKOS, GENUS *CYRTOPODION*: Dorsum with trihedral tubercles; caudal tubercles broadly in contact laterally with each other; male with preanal, rarely with femoral pores; a single row of transversally enlarged subcaudals.

This genus includes Pakistani species: *Cyrtopodion montiumsalsorum, C. kohsulaimanai, C. agamuroides, C. scaber, C. watsoni* and *C. kachhensis.*

SAND-STONE GEKKOS, GENUS *TENUIDACTYLUS*: Body and tail much depressed, tail much longer than body; dorsum with flat, round feebly keeled tubercles, arranged in longitudinal rows; in male 7-9 preanal pores, in some 6-9 femoral pores also present. Tail distinctly segmented, with broad dorsal and subcaudal scales. Pakistani species included are: *Tenuidactylus indusoani, T. rohtasfortai, T. fortmunroi* and *T. rhodocaudus.*

In the following section these genera are redefined and Pakistani gekkos assigned to them.

Ground-gekkos

Genus **Cyrtopodion** Fitzinger, 1843

Type species *Stenodactylus scaber* Heyden

1843 *Cyrtopodion* Fitzinger, Syst. Rep.:18, 93.

1984 *Mesodactylus* Szczerbak and Golubev, Vest. Zool., no.2:54.

Definition: dorsum with trihedral tubercles, arranged in longitudinal rows; caudal tubercles broad, keeled, broadly in contact with each other along their lateral sides, with 1-2 smaller tubercles at their base; male with preanal and in some species with femoral pores; single or rarely two rows of transversally enlarged subcaudals; 2-10 small post-femoral triangular tubercles.

This genus includes following Pakistani species:

Cyrtopodion montiumsalsorum (Annandale)

1913 *Gymnodactylus montiumsalsorum* Annandale, Rec. Ind. Mus. Calcutta, 9(5):313.

Type locality: Salt Range, Punjab, Pakistan.
Diagnosis: Khan (1989) redescribes this species. Pholidosic rage of this species: supralabials 9-11; infralabials 7-9; interorbital scales 11-13; scales across mid-belly 20-23; trihedral tubercles at mid-dorsal 12-13, in adult those of middorsal rows almost touching each other; number of tubercles in paravertebral row 21-23; subdigital lamellae under 4th toe 21-23; number of preano-femoral pores 26-32, preanal pores 5-7; midventral scale count 112-115; snout-vent length 32-47, tail length 39-56.6mm.
Colour pattern: Dorsum light gray, some dorsal tubercles dark, brown and white, giving the dorsum of body a variegated appearance. A darker stripe on nape, extending on temporals and orbit, five faint transverse bars on body; 13-14 dark bars on tail.
Range: Collected from different localities in Salt Range, northwestern Punjab, Pakistan, between 32-33^{o} N and 71-73^{o}30'E.

Cyrtopodion kohsulaimanai (Khan)

1991 *Tenuidactylus kohsulaimanai* Khan, J. herpetol., 25:199-204.
Type locality: Sakhisarwar village, Dera Ghazi Khan-Fort Munro Road, District Dera Ghazi Khan, Punjab, Pakistan.
Diagnosis: Supralabials 10-11, 7-8 infralabials; 14-17 interorbital scales; 13-14 rows of large trihedral tubercles at mid-dorsum, 27-28 in paravertebral row, tubercles not in contact with each other; 27-30 scales across mid-belly; 120-138 scales along midventrum; 6-10 preanal pores, 11-15 unilateral femoral pores, 30-40 preano-femoral pores in a continuous series; lamallae under 4th toe 23-25; snout-vent length 34-58, tail 64-80mm.
Colour pattern: light gray, with fine light-brown granulation all over; rows of dark dorsal tubercles alternate with those of white tubercles, in subadults 6-7 transverse bands which in some are divided in spots, tail with 11-12 dark cross bars. Legs and fingers barred.
Range: Collected between 29-30^{o} N and 69-70^{o} E, in the southwestern Punjab, at the foot of rugged Sulaiman Range.

Cyrtopodion scaber (Heyden)

1827 *Stenodactylus scaber* Heyden in Ruppell, Atl.Reise nordl.Afr. Rept.,:15.
Type locality: in the vicinity of Tor, Sinai.
Diagnosis: Data from Szczerbak and Golubev (1986) in open figures, that from Pakistan in parenthesis: Supralabials 10-14 (10-13), infralabials 7-10 (7-10); interorbitals 10-16(10-12); scales across midbelly 16-32(19-23); number of midventral scales 85-106 (89-120); preanal pores 4-9 (4-7) in male, no femoral pores; subdigital lamellae under 4th toe 19-27 (20-24); snout-vent length 34-53 (27-51), tail length (59-61) mm.
Colour pattern:Body dorsum khaki with 4-5 darker transverse bands formed of 3-5 spots, connected by thin transverse lines, tail 7-10 bands.
Range: From African coast of Red Sea, through Arabian Peninsula towards southwest Syria, southern Turkey, Iraq, Iran, Afghanistan, Pakistan to western border of Rajasthan desert, India.

Cyrtopodion potoharensis new species

Holotype: CAS 170532 (MSK 0639.87), an adult male, collected from crevices among bricks under road bridge, and cracks in the surrounding mudflats, near Lawrancepur Town,

District Rawalpindi, Rawalpindi-Attock Grand Trunk Road, 5th July, 1987, M. S. Khan (Fig. 1).

Paratypes(25): MSK 0640, adult male; MSK 0641, MSK 0643, MSK 0644, all adult females; MSK 0642, a juvenile, data for all as for holotype. Other localities (figures in parenthesis, number of specimens collected): Sakesar (7) from crevices in plastered wall and one from under tree bark; Chinji (5) and Jahangir Dehari (2) from under stones in nearby rocks; Malal (3) and Jaffer City (2) from among stone walls, all in Jhelum District, while Nazampur, Attock District (3) from crevices under a road bridge (Khan and Baig, 1988).

Diagnosis: Table 1 summarizes pholidosic and measurable characteristics of the type series of the new species. Medium sized gekko, patch of frontal scales large homogenous; parietals scales heterogeneous, rounded tubercular, rarely keeled; supralabials 10-15, infralabials 7-10, interorbitals 12-15; abdominals mostly squarish, 25-35 across midbelly, 121-145 along midventrum; dorsum with typical trihedral scales arranged in 12-15 rows across middorsum 10-15; subfemoral scales mostly squrish, 5-12 post-femoral tubercles; subdigital lamellae 19-23, preanal pores 6-7, mostly arranged in an angular arch, pore bearing scales large and distinct.

Snout-vent length 37-52, tail length 47-64 mm.

Colour: Dorsum light blueish with 3-4 squarish dark spots of different sizes, arranged in 5-8 transverse series from nape to the level of vent, tail with 10-12 dark bands. Limbs and digits heavily barred with black.

Variations: See Table 1.

Comparison with congeners: The new species is more close to *C. watsoni* than to *C. scaber*. It differs from both in having more (10-15) supralabials and interorbital scales (12-17). It has less scales across midabdomen (25-33) than 30-40 in *C. watsoni*. While, *C. kachhensis* has more scale (28-35) rows across midabdomen, and differs from new species in having two rows of subcaudals.

Range: The new species *Cyrtopodion potoharensis* was collected from different localities (32-33^{o}34' N, 72-73^{o} E) in central Potohar Plateau, after which the new species is being named.

***Cyrtopodion potoharensis* sp. nov.**

Cyrtopodion watsoni (Murray)

1892 *Gymnodactylus watsoni* Murray, Zool. Baloochistan S. Afghanistan,:68.

Type locality: Quetta, Balochistan, Pakistan.

Diagnosis: Supralabials 10-13, infralabials 7-10; interorbitals 12-16; scales across midbelly 35-40; number of midventral scales 140-170; 5-7 preanal pores in male, no femoral pores; snout-vent length 46-53, tail length 49-63mm; subdigital lamellae under 4th toe 22-26. Dorsum Khaki with 5-8 transverse m-shaped bands on body; 10-12 bands on tail.

Range: From northeast Afghanistan, northern and central Pakistan, it almost does not reach below 28^{o}N.

Cyrtopodion kachhensis (Stoliczka)

1872 *Gymnodactylus kachhensis* Stoliczka, Proc. Asiat.
Soc. Bengal, Calcutta, (1):79.

Type locality: Kachh Province, southwest India.

Diagnosis: Supralabials 10-12, infralabials 7-10; interorbitals 13-18; scales across midbelly 28-30; number of midventral scales 100-160; preanal pores in male 6-7, no femoral pores; snout-vent length 35-46, tail length 28-43 mm; number of subdigital lamellae under 4th toe 17-21; subcaudals longer than broad, in a double row. Snout-vent length 35-45, tail length 32-42.
Colour pattern: Khaki dorsum, with 4-5 darker bands on body, each formed of a transverse series of 3-5 spots, tail with 7-10 dark bands.
Range: From type locality Kachh, southeastern Sindh all along coastal strip (Szczerbak and Golubev, 1986) northward to Ziarat, Balochistan (Mertens, 1969). While, reports from Attock (Mertens, 1969), Lalian, Sargodha, Punjab, Pakistan (Khan, 1972) are based on misidentifications (Szczerbak and Golubev, 1996).

Khan (1997) revived *Gymnodactylus ingoldbyi* as *Cyrtopodion kachhensis ingoldbyi.*

Cyrtopodion kachhensis ingoldbyi Khan

1923 *Gymnodactylus ingoldbyi* Proctor, J. Bombay Nat. Hist. Soc., 29:121.
1997 *Cyrtopodion kachhensis ingoldbyi* khan, Russian J. Herptol., 4:83-88.
Type locality: Ladha, Dera Ismael Khan, southeastern North Western Frontier Province, Pakistan.
Diagnosis: Supralabials 10-12, infralabials 9-10; interorbitals 13-16; scales across midbelly 32-40; number of midventral scales 124-156; preanal pores 4-6 in male, no femoral pores; snout-vent length 48-65, tail length 37-52 mm; subdigital lamellae under 4th toe 19-23.

Medium sized angular-toed gecko with trihedral dorsal tubercles sides of the tubercles are bowed-in on a large flattened basal plate with sharp median dorsal keel; 14-16 interorbitals; 32-40 scales across midbelly, 149-156 scales in a line from suture between first pair of postmentals to anterior anal lip; 4-6 preanal pores, no femoral pores; an additional ventro-lateral row of subtrihedral caudal tubercles extending almost to the mid tail; 2-3 lateral cloacal tubercles; divided subcaudals, three rows to a segment; snout-vent length 37-50, tail 65-60 mm.
Colour pattern: Light to dark brown spots on light brownish dorsum, spots arranged in 4-6 transverse bands. tail barred with 9-11 darker bands.
Range: Sulaiman Range, southwestern Punjab and Dera Ismael Khan, southern North Western Frontier Province, Pakistan.

Cyrtopodion agamuroides (Nikolsky)

1900 *Gymnodactylus agamuroides* Nikolsky, Ann. Zool. Mus. for 1899, Spb [St. Petersburg], 4:384.
Type locality: Pensareh (Pendzhsara), eastern Kirman, Iran.
Diagnosis: 14-15 supralabials, infralabials 10; 16 interorbital scales; 28 scales across midabdomen, mid-ventrals 120; 21-22 subdigital lamellae under 4th toe; 2 preanal pores in male no femoral pores; tail with three rows of elongated arrow-head shaped subcaudals; , scales across midbelly 28; single pair of preanal pores. Snout- vent length 38.7, tail length 49.1 mm.

Colour pattern: 7 transverse bands on body each formed of 3-5 spots, 13 bands on tail, limbs barred.
Range: Minton (1966) records this gekko from Las Bela as *Agamura agamuroides* (Nikolsky).

Key to the Pakistani species of genus *Cyrtopodion*

1. Interspaces between tubercles much smaller than size of tubercles. 2
   Interspaces as large or larger than size of tubercles..... 3
2. Interorbital scales more than 14; dorsal tubercles often in contact with each other; mid-ventrals more than 120; snout-vent length less than 48 mm……..*Cyrtopodion montiumsalsorum*
   Interorbital scales less than 14; dorsal tubercles always separated by 1 to 3 granular imbricate scales; midventral scales less than 120; snout-vent length more than 50 mm.....*C. kohsulaimanai*
3. Two subcaudals to a caudal segment.....4
   Three subcaudals to a caudal segment.....*C. agamuroides*
4. Subcaudals small, as broad as long, in two rows.....*C. kachhensis*
   Subcaudals broader than long in a single row.....5
5. Scales across mid-abdomen less than 25.....*C. scaber*
   Scales across mid-abdomen more than 25.....….....6
6. Trihedral dorsal tubercles with straight lateral sides; 30-40 scales across midbelly.....*C. watsoni*
   Lateral sides of dorsal tubercles bowed in 25-33 scales across midbelly...*C. potoharensis*

Sand-stone gekkos

Genus ***Tenuidactylus*** Szczerbak and Golubev, 1984.
Type: *Gymnodactylus indusoani* Khan, 1988.

Definition: Body and tail depressed, tail much longer than body; dorsum with smaller rounded feebly keeled tubercles, arranged in more than 10 longitudinal and 20-28 paravertebral rows; 21 scales across midbelly; number of midventral scales more than 130; digits thin, breadth of basal and angular parts of the phalanges equal, distal part of phalanx

compressed, joints thick; subdigital lamellae broader than long; in male 4-7 preanal pores, in some species femoral pores also present. Tail distinctly segmented, with broad dorsal and single row of subcaudal scales.

Tenuidactylus indusoani (Khan)

1988 *Cyrtodactylus indusoani* Khan, J. Herpetology, 22 (2):241-243.

Type locality: Pirpeahai, Iskindarabad, District Mianwali, northwestern Punjab, Pakistan.

Diagnosis: 9-10 supralabials, 7-8 infralabials; 13-15 interorbitals; dorsal tubercles in 10-11 irregular longitudinal rows, in 24-26 paravertebral series; 21-24 scales across midbelly; 129-132 midventral scales; 4-5 preanal pores in male, no femoral pores; 24-25 subdigital lamellae under 4th toe; snout-vent length 48-51, tail length 72-76 mm.

color pattern: Dark mottling on snout and upper parts supralabials, a dark streak from behind eye on each side, connected with each other by narrow occipital band, continuing on sides of neck; 7 transverse bands from neck to the level of vent, each broken in a series of 3 or more
oval spots, with intervening similar smaller dots.

Range: Reported from sandstone hills in Mianwali District along Soan River.

Tenuidactylus rohtasfortai Khan and Tasnim

1990 *Tenuidactylus rohtasfortai* Khan and Tasnim, Herpetologica, 46:142-148.

Type locality: Ahmadyyah Mosque, Goi Madan, District Kotli, Azad Kashmir.

Diagnosis: 12-14 tubercles across mid-dorsum, 21-25 scales across midbelly; 102-132 midventral scales; 5-7 preanal pores in male, 6-10 femoral pores in a continuous series; 22-25 subdigital lamellae under 4th toe; snout-vent length 48-53, tail length 78-82 mm.

Colour pattern: Dorsal pattern of rounded spots is more evident in young specimens. In adults the spots tend to diffuse producing a mosaic of dark and light spots on body and limbs.

Range: Distributed from 73-75^{o} E and 33-35^{o} N, between an elevation from 650 m in central Punjab to 1600 m in southwestern Azad Kashmir.

Tenuidactylus fortmunroi Khan

1993 *Tenuidactylus fortmunroi* Khan, Pakistan J. Zool., 25:217-221.

Type locality: Khar Gardens, Fort Munro, District Dera Ghazi Khan, western Punjab, Pakistan.

Diagnosis: Body much depressed, habitus weak. Dorsal granular scales tubercular, juxtaposed, interspersed with 12 longitudinal rows of flat, keelless, 3-4 times larger round tubercles. Tail longer than body, segmented, with three rows of trihedral caudal tubercles on sides, subcaudals in a midventral transversally enlarged median series. Snout-vent length 48-50, tail 65-68 mm.

Colour pattern: Dorsum light brown, with a series of median 14 transverse dark bands, as broad as interspaces. Head light brown with dark mottling. A dark stripe from snout through eye extends back to join first band on nape. Dorsal tubercles of light colour form a mosaic dorsal pattern. Limbs with dark mottling. Gekkos found in buildings are light grey, with darker spottings, and no dark mottling on head and limbs.

Range: Known from type locality in Fort Munro and Khar village, in the northwestern, Dera Ghazi Khan District, Punjab, Pakistan.

Tenuidactylus rhodocaudus Baig

1998 *Tenuidactylus rhodocaudus* Baig, *Hamadryad*, 23(2):127-132.
Type locality: Tanishpa, District Kila Saifullah, Balochistan, Pakistan.
Diagnosis: Supralabials 10-11, 8-9 infralabials; dorsal tubercles round weekly keeled in 12-14 rows across middorsum; 16-18 scales across midbelly; 92-106 number of midventral scales; 5-9 preanal pores and 7/7 femoral pores in male; 22-24 subdigital lamellae under 4th toe; snout-vent length 30-64, tail length 31-74 mm.
Colour pattern: dorsum dusty, with dark brown speckling arranged in 9 indistinct broken cross bands, tail barred with pink and black in life.
Range: Known from its type locality.

Key to the Pakistani gekkos of genus *Tenuidactylus*

1. Only preanal pore present in male.....2
   Preanal and femoral pores in
   a continuous series.....3
2. Flat dorsal tubercles keeled.....*T. indusoani*
   Dorsal tubercles feebly keeled or
   keelless.....*T. fortmunroi*
3. 16-18 scales across midbelly; 92-106
   midventral scales.....*T. rhodocaudus*
   21-25 scales across midabdomen;
   midventrals 102-132.....*Tenuidactylus rohtasfortai*

Stone-gekkos

Genus **Mesodactylus** Szczerbak and Golubev, 1984

1984 *Mesodactylus* Szczerbak and Golubev, Vest. Zool., no.2:54.
Type species: *Gymnodactylus stoliczkai* Steindachner, 1868
Definition: Head and body moderately depressed, body and tail subequal; granular scales on dorsum tubercular, with elongated keel-less or slightly keeled tubercles; lateral constrictions of tail indicate segmentation, several rows of indistinguishable subcaudals; three dorso-lateral rows of short, blunt, conical, smooth flat caudal tubercles; only preanal pores present.

Mesodactylus stoliczkai is an extralimital species. Almost all herpetologists working on collections from northern Pakistan have placed every angular-toed gecko collected in the synonymy of *M. stoliczkai* without going into details of morphological comparisons: Smith, 1935 (*Gymnodactylus walli* Ingoldby, 1922); Minton, 1966 (*Cyrtodactylus mintoni* Golubev and Szczerbak, 1981) and Mertens, 1969 (*Cyrtodactylus dattanensis* Khan, 1980a), creating taxonomic chaos. Recent collections from circum-Himalayan region have shown that *M. stoliczkai* does not belong to

Pakistani gekkota (1992), moreover, all Pakistani gekkos placed in its synonymy are valid independent species.

Mesodactylus baturensis (Khan and Baig)

1992 *Tenuidactylus baturensis* Khan and Baig, Pakistan J. Zool., 24:273-277.

Type locality: Pasu, Gilgit Agency, Northern Pakistan.

Diagnosis: Gular region swollen; prominent endolymphatic swellings along sides of neck; 16-20 interorbitals; body dorsum with thin flattened to conical, weekly keeled tubercles in 11-12 longitudinal rows at midbody; dorsal granular scales tuberculated; 26-30 scales across midabdomen; midventral scales 149-171; no preanal and femoral pores; 24 subdigital lamellae under 4th toe; snout-vent length 52.4, tail 53.4 (+ regenerated, segmentation indicated by lateral constrictions.

Colour pattern: Body dorsum light, with faint band on neck, six on body with wavy margins, limbs and digits barred.

Range: Collected from type localities: Pasu (36^{o} 20'N, 74^{o} 50'E) and Khaiber, 36^{o} 35'N, 74^{o} 47'E, along western bank of the Hunza River, Gilgit Agency, Northern Pakistan.

Mesodactylus walli (Ingoldby)

1922 *Gymnodactylus walli* Ingoldby, J. Bombay Nat. Hist. Soc., 28:1051.

1935 *Gymnodactylus chitralensis* Smith, Fauna Brit. Ind., 2:46-47.

Type locality: Drosh Fort, Chitral, North Western Frontier Province, Pakistan.

Diagnosis: Tail longer than body; 20-21 interorbital scales; body dorsum with oval to round nontrihedral keel-less tubercles arranged in 10-13 longitudinal rows; 21-23 in paravertebral rows; 38-40 scales across midabdomen, 160-170 scales along mid-ventrum of body; 4-5 preanal pores in male. Lamallae under 4th toe 23-25. Snout-vent length 51-54, tail 78.4 mm.

Colour pattern: Dorsum light gray, with 9 transverse wavy brown bands on body. a dark stripe from eyes joins a band on nape. limbs barred, tail with 13 dark, 12 light bars.

Range: Chitral, North Western Frontier Province, Pakistan.

Key to the Pakistani gekkos of genus *Mesodactylus*

1. Dorsal tubercles round, nontrihedral,
   with raised center.....*Mesodactylus walli*
   Dorsal tubercles flat, with
   or without a keel.....…….....*M. baturensis*

Tibeto-Himalayan Group

Genus *Cyrtodactylus* Gray

Type species: *Cyrtodactylus mintoni* Golubev and Szczerbak, 1827.

Definition: Digits rather short, clawed, basal phalanx remarkably separated, underside with a number of smooth subdigital lamellae; second distal phalanx strongly compressed on sides, forming an angle with its proximally thickened part; 30-70 scales across head; only preanal pores present.

Cyrtodactylus mintoni (Golubev and Szczerbak)

1981 *Gymnodactylus mintoni* Golubev and Szczerbak, Vestn. Zool. Kiev, (3):40.

Type locality: Udigram, Swat, North Western Frontier Province, Pakistan.

Diagnosis: Type a female; 30 interorbitals; scales across midbelly 36; number of midventral scales 150; no preanal and femoral pores (male unknown); 17 subdigital lamellae under 4th toe. Snout-vent length 34.4, tail length 33 mm.

colour pattern: amber body colour, lemon on tail, dorsum with a series of 8 uneven, broken dark very thin bands, usually with posterior light border, breaking in smaller dark spots scattered on sides and head, tail and limbs; abdomen pale yellow. a brown strip, edged with white runs from nostril through eye to ear.

Range: Known only from Udigram, Swat, North Western Frontier Province, Pakistan.

Cyrtodactylus dattanensis Khan

1980 *Cyrtodactylus dattanensis* Khan, Pakistan J. Zool., 12:11-16.

Type locality: Datta, District Mansehra, Hazara Division, NWFP, Pakistan.

Diagnosis: body dorsum with round, keel-less tubercles arranged in longitudinal rows, abdominals 38-40; male with 8-9 preanal pores. tail rounded, not segmented, longer than body, subcaudals not enlarged. Snout-vent length 48-50, tail 50-53 mm.

Range: Widely distributed in alpine Punjab and eastern North Western Frontier Province, Pakistan.

Cyrtodactylus battalensis (Khan)

1993 *Tenuidactylus battalensis* Khan, Pakistan J. Zool.,
25:67-73.

Type locality: Batgram Town, District Mansehra, North Western Frontier Province, Pakistan.

Diagnosis: Dorsum with obtusely keeled flattish tubercles; 50-52 across midabdomen; 199-205 midventrals; 9-10 preanal pores arranged in an arch, no femoral pores, tail unsegmented, subcaudals small; Snout-vent length 60-64, tail 63-64 mm.

colour pattern: Light brown dorsum, with 7 transverse dark brown bands, much narrower than interspaces, with irregular margins which at places meet each other to form a reticulum, extending along sides. a vivid dark stripe from side the side of snout through loreum, joining first band on body. limbs with dark reticulation.

Range: Known only from its type locality, Batgram, District Manshera, North Western Frontier Province, Pakistan.

Key to Pakistani species of genus *Cyrtodactylus*

1. Three nasal scales; dorsal pattern of
   transverse bands which are much narrower
   than interspaces, tending to break in spots
   on sides .....*Cyrtodactylus mintoni*
   Two nasal scales; dorsal pattern of
   transverse bands, band as broad or
   broader than interspaces.....2
2. Dorsal bands broader than interspaces;

mid-ventrals 85 to 162.....*C. dattanensis*
Dorsal bands breaking into a reticulum;
mid-ventrals 194 to 205.....*C. battalensis*

Geographical distribution of angular-toed gekkos of Pakistan

Tectonic activity, in the northern part of the subcontinent during Eosine-Miocene periods (40-23 million years ago), shaped present day Himalayan-Siwalik and Indo-Gangetic flood plain scenario. The disappearance of Tethys Sea (10-15 million years ago) opened up east-west and west-east pathways for migration along Himalayas, Indo-Gangetic flood plains and along coastal strip (Khan, 1980b; Leviton and Anderson, 1984). Thus free gene exchange between Indo-Malaysian and Palearctic species was made possible. Moreover, corresponding rapid climatic changes and setting up of monsoon seasoning afforded isolation for the perpetuation of the variants. Thus several newly created habitats were conducive for species diversity resulting from convergence of the Indo-Malaysian, Saharo-Sindhian and Eurasian species.

The ancestral *pulchellus*-like cyrtodactylid gekko invaded north along the subHimalayas, well before mountain-basin and alluvial-fan building process started after Plio-Pleistocene tectonic activity. The rapid degradation of stream and river beds resulted in break up of sedimentary bedrock and flood plains into wide array of sandstone blocks and mud flats all along the foot hills. Crevices and cracks among sandstone rocks and mudflats created formidable barriers to interdeme gene exchanges among gekkos. Thus so isolated, the ancestral gekkos rapidly proliferated and invaded different habitats created in the foothills.

The mudflats were colonized by Palearctic gekkos with trihedral dorsal tubercles of genus *Cyrtopodion* which are now represented in Pakistan by several taxa: Saharo-Sindhian *C. scaber* is the most widely distributed (23-45^{o} N, 30-76^{o} E). The Seistanian *C. agamuroides* is mostly coastal (26-27^{o} N, 60-66^{o} E). Of the endemic species *C. kachhensis* is coastal, extends northwards in Balochistan and proliferates in the mountain ranges (24-33^{o} N, 66-72^{o} E), recently its northern race *C. kachhensis ingoldbyi* has been recognized (Khan, 1997), while *C. watsoni* (26-72^{o} N, 65-72^{o} E), *C. kohsulaimanai* (29-30^{o} N, 69-70^{o} E), *C. montiumsalsorum* (32-33^{o} N, 71-74^{o} E) and the new species *C. potoharensis* (32-34^{o} N and 72-73^{o} E) are widely distributed endemic forms occurring throughout the Salt Range area in the northwestern Punjab, Pakistan.

The sandstone rocks along old river courses are inhabited by peculiar depressed bodied gekkota belonging to genus *Tenuidactylus.* Recently several endemic species have been described from throughout Pakistan: *T. indusoani* from Pirpeahai, District Mianwali, Punjab, Pakistan (33^{o} N, 71^{o} E); *T. rohtasfortai* (73-75^{o} E, 33-35^{o} N), from central Punjab and northwestern Azad Kashmir; *T. fortmunroi* from Fort Munro in the Northwest Punjab, (22^{o}53' N, 70^{o}23' E), and *T. rhodocaudus* from Toba Kakar Range, western Balochistan (31^{o}12'N, 68^{o}28' E), have been described.

The high altitude rocks are invaded by circum-Himalayan gekkos of genus *Mesodactylus*. Their eastern s*toliczkai* group occurs in Baltistan, includes extralimital *Mesodactylus yarkendensis* (38^{o}40'N, 77^{o} 50'E) and *M. stoliczkai* which is confined to

Ladak, between 34-35°45' N, 75-76°70'E (Annandale, 1913; Schmidt, l922; Gruber, 1981; Khan, 1994, in press). The only highland Pakistani gecko *M. baturensis* is reported from Gilgit Agency at 36°20'N, 74°50' E. While in the western Himalayas occurs the *walli*-group of Circum-Himalayan gekkos: *M. walli* ranges between 35-36° N, and 71-72° E), while the extralimital Iranian gecko *M. kirmanensis* at 30° N, 58° E, in Iran (Szczerbak and Golubev, 1986).

The Tibito-Himalayan group is closest to the ancestral southeast Asian cyrtodactylid stock, and is widely distributed in the subHimalayas of Pakistan and adjacent Kashmir (Khan, 1993). Three species occurs in Pakistan: *Cyrtodactylus mintoni (*33°08' N, 72°21' E); *C. dattanensis* (33-34°18' N, 73-74° E) and *C. battalensis* (34°40' N, 73°03' E), while extralimital species *C. himalayanus* (Duda and Sahi, 1978) occurs in Kashmir at (32-33° N, 74-76° E).

Evidence is mounting in favor of the idea that family Gekkonidae evolved in the southeast Asia and dispersed westward through southwestern Asia into Indo-Pakistan and Africa (Kluge, 1967; Szczerbak and Golubev, 1986). Worldwide distribution of gekkos is largely known due to human transportation (Darlington, 1957). The circum-oceanic coastal forms are carried by sailors from coast to cost, however, some of the species have penetrated deep inland (Khan, in press). Recent evidence for westward dispersal of cyrtodactylid gekkos of southeast Asian stock along the subHimalayas, is suggested by the description of several gekkos along westward ancient migration routs of *Budh* tribes in past and continuing seasonal high-low-high altitude migrations of local people (Duda and Sahi, 1978; Khan, 1980a, 1988, 1993, in press; Golubev and Szczerbak, 1981). Massive Pagoda buildings and temples, in the area, are the most frequent haunts of these gekkos in the southeast Asia. Similar example of human transportation is strongly suggested by the recent record of few individuals of Palearctic gekko *Hemidactylus persicus* from Rohtas Fort, Jhelum valley, Punjab, Pakistan, far west of Balochistan where the gekko occurs as common house-gekko (Khan, 1987; Khan and Ahmed, 1987; Khan and Tasnim, 1990). The fort was built in 15th century, between years 1542-1550, with sandstone blocks mostly transported from Balochistan. The Persian gekko is not reported from Punjab (Khan and Tasnim, 1990). The disjunct population in Rohtas Fort probably represent descendants of few individuals which were transported along sandstone blocks. The individuals in the fort are in severe competition with indigenous common house-gecko *H. flaviviridis*, which is dominant throughout the fort, while few *persicus* individuals are holding on to remote recesses of the fort, and *Tenuidactylus rohtasfortai* and *Cyrtopodion montiumsalsorum* are pushed to the boundary walls of the fort (Khan, 1989; Khan and Tasnim, 1990).

Appendix 2

Abbreviations used

BMNH=British Museum, Natural History, London; CAS=California Academy of Sciences, California, USA; MSK=Herp laboratory, 15/6 Darul Saddar North, Rabwah 35460, Pakistan (author's personal collection); NMW=Naturhistorisches Museum Wien, Austria; SR=Institute of Zoology, Academy of Sciences, Kiev-30,

Ukrain; UF=Florida State Museum, Gainesville, USA; USNM=National Museum of Natural History, Washington, D.C.

Appendix 2

Additional material examined

Cyrtodactylus battalensis BMNH 1990.2; *C. 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; *C. yarkandensis* BMNH 72.3.22.4; *C. tibetinus* CAS 196850, CAS 196854; *Gymnodactylus walli* BMNH 1910.7.12.1; *G. chitralensis* BMNH 1946.8.23.19; *Tenuidactylus baturensis* BMNH 1990.3; *T. 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.

Legend to the photograph

Fig.1. *Cyrtopodion potoharensis* New species, holotype, CAS 170532 (MSK 0639.87).

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