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A New Lizard of the Genus *Gekko* Laurenti, 1768 (Squamata: Sauria: Gekkonidae) from the Phong Nha - Ke Bang National Park, Quang Binh Province, Vietnam¹

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Abstract. We describe a new species of the genus *Gekko* from the karst forest of the Phong Nha - Ke Bang National Park, Quang Binh Province, Vietnam. *Gekko scientiadventura* sp. n. is distinguished from all other *Gekko* species occurring in Vietnam by the lack of dorsal tubercles. From the four species of *Gekko* that do not occur in Vietnam and that have likewise no dorsal tubercles (*athymus*, *melli*, *subpalmatus*, and *tawaensis*), the new species may be distinguished as follows: *G. athymus* has more preanal pores than *G. scientiadventura* sp. n. whereas in *G. tawaensis* both preanal and femoral pores are completely lacking. *G. melli* and *G. subpalmatus* are apparently closer related to *G. scientiadventura* sp. n., but in these two species the nasorostrals are separated from each other by internasals. We provide first data on habitat and natural history of the new species and furthermore provide a key for the Vietnamese *Gekko* species.

Key words. *Gekko scientiadventura* sp. n.; karst forest; taxonomy, natural history.

1. INTRODUCTION

According to BOBROV (1995), six species of the genus *Gekko* exist in Vietnam: *G. badenii* Szczerbak & Nekrasova, 1993, *G. chinensis* (Gray, 1842), *G. gecko* (Linnaeus, 1758), *G. japonicus* (Schlegel, 1836), *G. palmatus* Boulenger, 1907 and *G. ulikovskii* Darevsky & Orlov, 1994. However, according to the investigations of OTA et al. (1995) the occurrence of *G. japonicus* in northern Vietnam (see also NGUYEN & HO 1996) must be regarded as doubtful. Not yet contained in BOBROV's (1995) list is *G. grossmanni* Günther, 1994. SCHLÜTER (1999) claims *G. petricolus* Taylor 1962 to occur in the "triangle of Thailand, Vietnam, and Cambodia", but definite Vietnamese records of this species are - to our best knowledge - still lacking. The incomplete state of knowledge of Vietnam's gekkonid fauna is also highlighted by the recent description (1993-1994) of the three species of the genus *Gekko* mentioned above (for the correct year of description of *G. badenii* see GÜNTHER 1994).

When we started our herpetological investigations of the Phong Nha - Ke Bang karst forest, in the Quang Binh

Province close to the Laotian border seven years ago, aside from *Gekko gecko* only three species of *Hemidactylus* were known (ZIEGLER & HERRMANN 2000). During our subsequent studies of the herpetological diversity of this area we were able to record three additional species in the National Park: *Gehyra mutilata* (Wiegmann, 1834) and an undescribed species of each of the genera *Cyrtodactylus* and *Gekko* (ZIEGLER et al. 2004). The former has been described already by ZIEGLER et al. (2002), but the latter, listed still as *Gekko* sp. by ZIEGLER et al. (2004), will be diagnosed and described below.

Because in the aforementioned papers the Phong Nha - Ke Bang National Park, its herpetofauna and the respective conservation needs have already exhaustively been described, we restrict ourselves in the present paper on the diagnosability of the new species of *Gekko*.

2. MATERIAL AND METHODS

Voucher specimens are deposited in the Vietnam National University (HNUV), Hanoi, in the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, and in the personal collection of the senior author (CPHR). Comparative material was provided (cadens according to LEVITON et al. 1985) by the Natural His-

¹ In commemoration of Clas Michael Naumann zu Königsbrück (26.06.1939 – 15.02.2004)

tory Museum (BMNH), London, and the Museum für Naturkunde (ZMB), Berlin.

Biometric and scalation characters as well as colour pattern data were evaluated in both living and preserved specimens. Measurements were taken with a dial caliper (to the nearest mm). The following abbreviations are used: a.s.l. = above sea level, SVL = snout vent length, TL = tail length, SE = distance from snout tip to front of eye, EE = distance between hindmargin of eye to hindmargin of ear, HW = maximum head width, HH = maximum head height, HL = head length (from tip of snout to hindmargin of ear). The following scale counts were taken: supralabials (SPL), sublabials (SBL), nasals (N); in direction from rostral to labial: nasorostrals, supranasals, postnasals, internasals (IN); postmentals (PM), gulars bordering the postmentals (GP), interorbitals (IO), ventrals (V), scales around midbody (SB), subdigital lamellae under the first (LT1) and fourth toe (LT4), preanal pores (PP), postanal tubercles (PAT), dorsal scale rows in the middle of the third caudal whorl (S3R). In living specimens symmetrical scale counts were taken only on the lizard's right side. Colouration is described according to the standard plates published by GRALLERT & ROLAND (1960).

3. RESULTS

3.1. Description of *Gekko scientiadventura* sp. n.

3.1.1. Diagnosis. A small-bodied species of *Gekko*. The biggest specimen (captive) has a total length of 154 mm, of which 81 mm are made up of the tail. Habitus slender, head distinctly broader than neck, head and body slightly depressed. Unregenerated tail always longer than head-body length, not constricted at its base, not thickened, slightly depressed. Lateral fold weak, upper side of head, body and tail without tubercular scales. Digits and toes slightly webbed at the base, only interspace between toes 4 and 5 not webbed. All digits and toes, except the inner ones, clawed. 14-17 subdigital lamellae below fourth toe. 5-8 preanal pores. Nostril touches rostral. No internasals. Posterior ciliaries spiny. Upper side yellowish to brownish in life. Dorsally seven large light spots that may be expanded to lateral narrow wavy bands. Tail with 7-10 light crossbands. Gular region and parts of venter marbled.

From all species of *Gekko* known to occur in Vietnam (*G. badenii*, *G. chinensis*, *G. gecko*, *G. japonicus*, *G. palmatus*, *G. ulikovskii*), *G. scientiadventura* sp. n. is invariably distinguished by the lack of middorsal tubercles. For more detailed comparison, also with other *Gekko*-species see below (3.4. and 3.5.).

3.1.2. Holotype. ZFMK 76198, adult male, Figs. 1-3, primary limestone forest, Phong Nha - Ke Bang, surroundings of 17.32 N, 106.16 E, ca. 50-150 m a.s.l.,

Quang Binh Province, Vietnam, coll. H.-W. HERRMANN, VU NGOC THAN & T. ZIEGLER, 27-29 August 2001.



Fig. 1: Live holotype of *Gekko scientiadventura* sp. n. (ZFMK 76198). Phot. T. ZIEGLER

3.1.3. Description of the holotype. Total length 128 mm (for more measurements and indices see Table 1). Rostral twice as broad as high, narrower than mental, without a median suture. 13/12 supra- and 11/10 sublabials. Nostril touches rostral and 1st supralabial. 3/3 nasals, nasorostrals in contact medially. Nasorostrals twice as big as postnasals. Pupil vertical. Tympanum obliquely oval, ca. half of the eye diameter. Interorbital scale count 44. Mental triangular, as broad as high. Two postmentals, twice as long as broad and of subequal length with the 1st supralabial. Postmentals posteriorly touched by six scales. Lateral scales of snout about three times bigger than those on the dorsal side of the snout, roundish, juxtaposed. Head scales granular, ciliaries posteriorly spiny. Gular scales granular, about the same size as upper head scales. Dorsal scales round, smooth, juxtaposed, convex, ca. 1.5 times bigger than head scales. Ventral scales flat, smooth, imbricate, three times as big as dorsals, 41 in an oblique row between the weakly developed lateral folds. Midbody scale count 140. Scales on the upper surface of the upper fore- and hindlimbs flat, smooth and imbricate, granular on the lower. Lower parts of all limbs with granular scales. Fingers and toes basally weakly webbed, only toes 4 and 5 without webbing. 14/12 lamellae under the 1st and 17/15 under the 4th toe. 5 preanal pores arranged in an angularly bent series, 3/3 postanal tubercles. Upper caudal scales flat, subimbricate, as big as the dorsals, arranged in regular transverse rows and weakly expressed whorls, the 3rd whorl being composed of (dorsally) 10 scale rows. Subcaudals flat, smooth, imbricate, 2.5 times wider than high, with a median row of regularly arranged plates; each 3rd plate ca. 3 times as broad as high, marking the beginning of whorl. Laterally, the subcaudals are bordered by alternating scales (2-2-3-2-

2-3-2-2 ...) where scales each are bordering the respective broader subcaudal plate.



Fig. 2: Ventral view of the live holotype of *Gekko scientiadvventura* sp. n. (ZFMK 76198). Phot. T. ZIEGLER

Hemipenial morphology. Right hemipenis (Fig. 3: terminology after RÖSLER 1998) 2.2 mm wide, 4.6 mm long, clavate, forked. Pedicel and truncus not differentiated from each other; basally on the sulcal side is a small wrinkled adminiculum, running laterocranially and not reaching the sperm groove. Above the adminiculum a ribbed area. Apex bilobed, the lobes being subequal in size. Sperm groove originates from the latero-caudal side of the organ and runs straight along the truncus, where it divides into two branches that terminate on the upper side of each lobe in a slit-like concavity. Apically, the sperm groove is shallow and is accompanied by weakly developed sulcal lips. The sperm groove gets deeper and widens towards the proximal part of the truncus. The epidermal tissue of the lobes appears to be rough, although no calyces can be distinguished.

Colour of preserved holotype. Upper side of head and body dark grey. Head grey-brown, with darker vermicu-

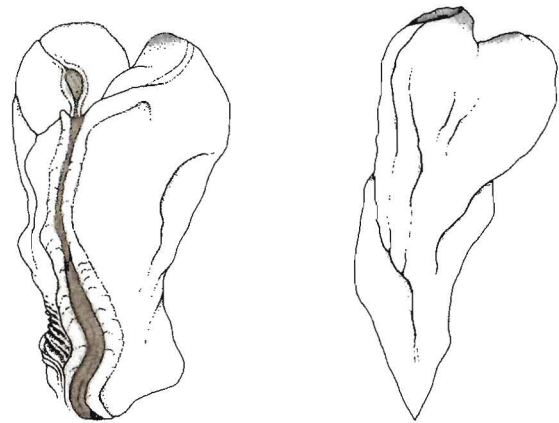


Fig. 3: Right hemipenis of the holotype of *Gekko scientiadvventura* sp. n. (ZFMK 76198): a) sulcal, b) asulcal view. Drawing: H. RÖSLER.

lations and flecks, additionally small light dots. Dorsum with seven median light flecks that continue laterally into small transverse bands with strongly waved anterior and posterior margins. These transverse bands are anteriorly bordered by brown-blackish lines and dissolve laterally. Between the single bands light flecks and numerous small spots are interspersed. Limbs above dark grey with grey-brown stripes. Throat, chest and belly buff, the throat bearing a reticulate pattern. Belly laterally with light spots. Forepart of tail above and below dark grey, hindpart grey-black. Nine grey-brown transverse bands on the upper side of tail, the hindmost five reaching the lower side of the tail and nearly form closed rings.

3.1.4. Paratypes. ZFMK 76174 (Fig. 4), adult female, ZFMK 76175-179, juveniles, Phong Nha - Ke Bang, surroundings of 17.32 N, 106.16 E, 50-150 m a.s.l., Quang Binh Province, Vietnam, coll. H.-W. HERRMANN, VU NGOC THANH & T. ZIEGLER, 26 August - 1 September 2001. ZFMK 80651-652, adult females, same locality data, coll. VU NGOC THANH & T. ZIEGLER, 29 August - 10 September 2003.

Paratypes ZFMK 76179 and 80652 will be permanently transferred to the scientific collection of the Vietnamese National University, Hanoi (HNUV).

3.1.5. Description of paratypes. Individual body measurements and proportions can be seen in Table 1. For the latter, the paratypes have the following mean values and standard deviations (n being variable): SVL:TL 0.87+/-0.07, SVL:HL 3.49+/-0.24, HL:HW 1.28+/-0.03, HL:HH 2.28+/-0.03, SE:EE 1.33+/-0.09.

All paratypes possess invariably 3 nasals, no internasals and 2 postmentals. Further, females and juveniles are lacking preanal pores. The postmentals are differently shaped, the maximal relative length is the left postmental of ZFMK 76176 which is three times as long as



Fig. 4: Live female paratype of *Gekko scientiadventura* sp. n. (ZFMK 76174). Phot. T. ZIEGLER



Fig. 5: Portrait of one of the captive males of *Gekko scientiadventura* sp. n. (see also fig. 28 in ZIEGLER et al. 2004) from 22 April 2003, measuring a SVL of 67 mm and a TL of 70 mm at the time; note the spiny posterior ciliaries as well as the bordering nasorostrals. Phot. T. ZIEGLER

broad. The right postmental is divided in ZFMK 76176 and 76178. The posterior ciliaries are spiny in all paratypes. The remaining scalation characters vary to a small degree only (see Table 2). Range (mean and stan-

dard deviation) of the number of supralabials is 12-14 (13.00 ± 0.82), of the sublabials 9-13 (9.94 ± 1.26), of the scales behind postmentals 5-7 (5.67 ± 0.71), of the interorbitals 41-49 (43.75 ± 3.59), of the ventrals 38-48 (41.80 ± 3.90), of the scales around midbody 118-139 (132.20 ± 8.23), of the lamellae under the 1st toe 12-15 (13.86 ± 1.03), of the lamellae under 4th toe 14-17 (15.64 ± 1.15), of the postanal tubercles 2-3 (2.50 ± 0.53) and of the number of dorsal scales in the 3rd tail whorl 10-11 (10.29 ± 0.49).

All juvenile paratypes (as well as two embryos, see 3.1.6.) have still two egg teeth which touch each other apically as it is typical for geckos with relative thick and calcified eggshells (RÖSLER 2001b). The tooth crown of the egg teeth has a shape similar to that of *G. gecko* (see SLUITER 1893).

Colour of preserved paratypes. The pattern of the preserved material corresponds to that of the living animals, the overall colouration being more greyish.

3.1.6. Other material. Next to the type series, there are two male embryos (ZFMK 76199 and CPHR 2028) and three eggshells (ZFMK 76180) from the same locality. The embryonic males exhibit egg teeth as described above, their hemipenes are completely everted, deeply forked and show two subequal apical lobes. In one of them (CPHR 8028) the dark pigments (6 crossbands) start to develop.

In addition there are three males and one female (Figs. 5-7, see also fig. 28 in ZIEGLER et al. 2004) that had hatched in September/October 2001 from eggs found in a karst cave at the type locality in August 2001, and which are kept alive in the Cologne Zoo.

3.1.7. Colouration in life. Variable in all adults. Basic colour either more brownish marbled with yellowish flecks, or yellowish with brownish marbling. Upper side of head with large, blackish-brown flecks or spots which may be present also on the snout. Some specimens additionally possess some greyish flecks on the same head regions. Ciliary scales black with yellow margins. Iris metallic green-yellowish, pupil with bronze-coloured margin. A row of 7 middorsal grey flecks which may be extended to wavy crossbands of the same colour towards the flanks. These crossbands may be dissolved into flecks. The middorsal flecks are anteriorly bordered with a blackish brown pattern that is w-shaped in the neck region. The grey crossbars on the tail are likewise anteriorly bordered by blackish brown pattern elements. The grey flecks on the limbs are bigger on the hind legs. Throat and belly with more or less distinct lemon to buff colouration, with more or less distinct brown-olive marbling. Colour pattern of underside of tail variable, with pale or dark grey to ochre or blackish brown flecks.

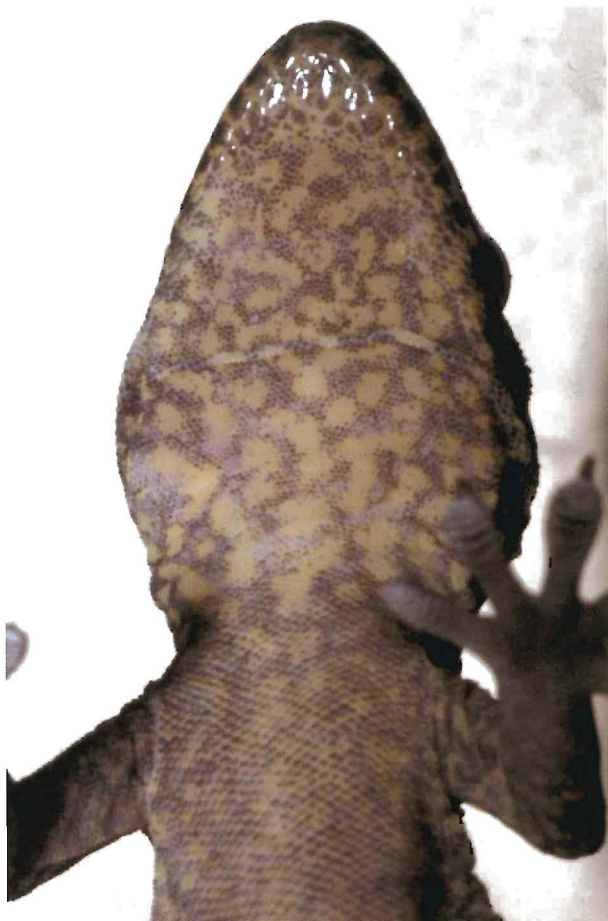


Fig. 6: Gular region of the male of *Gekko scientiadventura* sp. n. depicted in Fig. 5 (10 November 2003). Phot. T. ZIEGLER



Fig. 7: Captive female of *Gekko scientiadventura* sp. n. (10 November 2003); note the regenerated tail. Phot. T. ZIEGLER

3.1.8. Etymology. The species name is a patronym for a scientific magazine programme of the German Television channel ZDF called “Abenteuer Wissen” (adventure of knowledge) in order to acknowledge the first documentation of the Phong Nha - Ke Bang National Park biodiversity for the German public. First live pictures of *Gekko scientiadventura* sp. n. were shown on

this TV programme. The name is derived from the Latin words “scientia” (knowledge, science) and “adventura” (literally = things that will come = adventure) and is a noun in apposition.

3.2. Distribution

So far, *Gekko scientiadventura* sp. n. is known only from the type locality (Fig. 8). Although currently regarded as endemic for Vietnam, its occurrence in Laos cannot be excluded, considering the proximity of the Laotian border from the type locality.



Fig. 8: Position of the type locality within Quang Binh Province.

3.3. Natural history

All specimens of the type series were collected at night in primary forest, either directly on or in the immediate neighbourhood of the karst limestone outcrops that were partly overgrown with vegetation (Fig. 9). The geckos were mostly seen on the vegetation in low height (1.0–2.5 m) rather than on the bare rocks. In contrast, these bare rocks were mostly populated by the syntopic and only recently described bent-toed gecko *Cyrtodactylus phongnhakebangensis* which, in turn, tended to avoid

the vegetational parts of the microhabitat (ZIEGLER et al. 2002).



Fig. 9: Habitat of *Gekko scientiadventura* sp. n. near the type locality. Phot. T. ZIEGLER

Apart from the voucher material of our type series no further sightings of *Gekko scientiadventura* sp. n. were made, with the exception of a mass egg-laying site in a dark, manifold rock crevice system at the type locality. Fig. 10 shows this site (in about 2.5 m height) at the beginning of the rainy season (end of August) in 2001. The four geckos cited under "Other material" originate from these eggs; they hatched in September/October 2001 which correlated with the beginning rains. One year later, in August 2003, we found two glued eggs just at this mass egg-laying site. In addition, two further communal egg-laying places were found in this cave system which seemed to be used also already since a longer period; they contained, however, much less eggs and were situated much higher (ca. 5 m high).

On August 30, 2003, we measured at the lower egg-laying site, at 14.30 h, a relative humidity of 85% and a temperature of 27.3 °C. At 21.40 h the same day the temperature was 26.3 °C and the relative humidity had



Fig. 10: Mass egg-laying site of *Gekko scientiadventura* sp. n. in a karst rock crevice at the type locality. Phot. T. ZIEGLER

increased to 93% (with a recorded minimum of 70% between 14.30 and 21.40 h). In the primary forest, outside the rock crevice system, we measured with a minimum-maximum thermometer on August 28, 2001 24.4-30.2 °C and one day later 24.3-27.8 °C. For further (long-term) climatic data from this area see HERRMANN et al. (2002).

One of the authors (TZ) was able to record some behavioural and autecological observations of the captive-raised geckos: The growling calls of *Gekko scientiadventura* sp. n. were mostly uttered during dawn and night, but could also be heard in summer afternoons (e.g. 22-26 July, 2002), i.e. during the light phase of the terrarium. Obviously, also the black-and-white annulation of the tail plays a role in the infraspecific communication between both sexes, because in an interacting couple the tails were raised and displayed with undulating movements. A male that was taken out of its terrarium used to wag its tail in a much faster manner. Once an acinetic reaction could be observed, a lethisinulation with a recurved tail and extremities that were raised from the ground and standing off from the body. The geckos were fed mainly with crickets of various size classes that were powdered with a vitamin-mineral mixture, however, they were repeatedly observed to lick on and even to bite off small pieces of bananas. In 2003, two egg-layings occurred but the paired, partly deformed clutches proved to be unfertilised.

3.4. Comparison with other Vietnamese *Gekko* species

Next to the lack of dorsal tubercles, *Gekko scientiadventura* sp. n. can be distinguished from its Vietnamese congeners by the combination of the characters size, number of internasals and preanal pores as well as dorsal pattern:

G. badenii reaches a SVL up to 76.5 mm and has 1-3 internasals; males have 14-18 preanal pores, and the dorsal pattern consists of 4-8 very narrow and sometimes

even interrupted dorsal bands (SZCZERBAK & NEKRASOVA 1994).

G. chinensis (synonym: *G. semipalmatus* Stejneger, 1932) reaches a SVL up to 70 mm. Always 1 internasal which exceeds the nasorostral in size. Males have 18-24 preanal pores. Dorsally 4 indented, cloudy crossbands with light flecks in between (OTA et al. 1995). *G. semipalmatus* has 10 more or less regularly arranged longitudinal rows of dorsal tubercles and the males have 23 preanal pores (STEJNEGER 1932).

G. gekko of Vietnamese origin reach a SVL up to 173 mm. 0-1 internasal. Males have 13-20 preanal pores. Dorsum with transversely and more or less regularly arranged light flecks and dark (brownish to reddish) bands, flecks and stripes (own data). We recognize the following synonyms of *Gekko gekko* (sensu lato): *G. verticillatus* Laurenti, 1768; *G. teres* Laurenti, 1768; *G. perlatus* Houttuyn, 1782; *G. guttatus* Daudin, 1802; *G. verus* Merrem, 1820; *G. annulatus* Kuhl, 1820; *G. indicus* Kuhl, 1857. All taxa considered as synonyms here have (according to their descriptions) dorsal tubercles. We are uncertain in synonymizing *G. aculeatus* Houttuyn, 1782 with *G. gekko* (see also KLUGE 1993, 2001). DAUDIN (1802) considers this name to be synonymous with *Tarentola mauritanica* Linnaeus, 1758 (see also RÖSLER 2001 a). Moreover, we recognize the subspecies *G. g. azhari* Mertens, 1955. Validity and status of *G. reevesii* Gray, 1831 will be discussed elsewhere (RÖSLER & ZIEGLER in prep.). Both last-named forms differ by their size, the dorsal tubercles and the colour pattern unequivocally from *G. scientiadventura* sp. n.

G. grossmanni reaches a SVL of 89 mm. 0-1 internasal. Males with 12-14 preanal pores. Dorsum with several rows of more or less transversally arranged light flecks (GÜNTHER, 1994).

G. japonicus reaches a SVL length of 74 mm and has 1-2 internasals. Males have 6-9 preanal pores. Dorsum with 6 indented dark crossbands which are medially interrupted by light flecks (STEJNEGER 1907; ZHAO et al. 1999; own data). BOURRET (1937) described a male *G. japonicus* from Ngan Son, Tonkin (northern Vietnam) with a SVL of 71 mm as "identique à la description originale, avec une ligne de 10 pores préanaux de chaque côté" (see also BOURRET 1939 and his unpublished manuscript, pp. 34-36). A second locality, Bac Thai, was recorded by NGUYEN & HO (1996). According to OTA et al. (1995), the gekko described by BOURRET belongs to *G. palmatus*. Synonyms of *G. japonicus* are *Platydictylus jamori* Temminck & Schlegel, 1838 and *Hemidactylus nanus* Cantor, 1842. The original description of *H. nanus* contains only notes on the colour pattern (CANTOR 1842), but both types (BMNH 1946.8.26.9-10) have tubercles on back, limbs and tail (pers. comm. C. MCCARTHY).

G. palmatus reaches a SVL of 79 mm and has 0-2 internasals. Males have 24-27 preanal pores. Dorsum including occipital and nuchal region with 6 rows of dark flecks with lighter interspaces (OTA et al. 1995).

G. ulikovskii reaches a SVL up to 108 mm and has one internasal. Males have 10-15 preanal pores. Dorsum with up to eight narrow, light dorsal bands (DAREVSKY & ORLOV 1994).

3.5. Comparisons with the remaining *Gekko* species

According to the original descriptions of all *Gekko* species not occurring in Vietnam, the lack of dorsal tubercles sets *G. scientiadventura* sp. n. unequivocally apart from: *G. albofasciolatus* Günther, 1867; *G. auriverrucosus* Zhou & Liu, 1982; *G. gigante* Brown & Alcala, 1978; *G. hokouensis* Pope, 1928 (synonym: *Luperosaurus amissus* Taylor, 1962); *G. kikuchii* Oshima, 1912; *G. liboensis* Zhou & Li, 1982; *G. mindorensis* Taylor, 1919; *G. monarchus* Schlegel, 1836 (synonyms: *Platydictylus burmeisteri* Giebel, 1861; *P. deissneri* Giebel, 1861); *G. palawanensis* Taylor, 1925; *G. petricolus* Taylor, 1962; *G. porosus* Taylor, 1922; *G. romblon* Brown & Alcala, 1978; *G. scabridus* Liu & Zhou, 1982; *G. siamensis* Grossmann & Ulber, 1990 (synonym: *G. taylori* Ota & Nabhitabhata, 1991); *G. similignum* Smith, 1923; *G. smithii* Gray, 1842 (synonyms: *Platydictylus stentor* Cantor, 1847; *P. albomaculatus* Giebel, 1861); *G. swinhonis* Günther, 1864; *G. verreauxi* Tytler, 1864; *G. vittatus* Houttuyn, 1782 (synonyms: *Lacerta unistriata* Shaw, 1792; *Stellio bifurcifer* Schneider, 1792; *Platydictylus bivittatus* Duméril & Bibron, 1836; *G. trachylemus* Peters, 1872); *G. yakuensis* Matsui & Okada, 1968.

According to the English summary of the Chinese original description of *G. taibaiensis* Song, 1985, this species is closely related to *G. swinhonis* and *G. japonicus* (SONG 1985). From these, *G. taibaiensis* differs by fewer preanal pores (4-6) which are arranged in an interrupted order. The maximum SVL is 69 mm, and there are 7-8 subdigital lamellae under the fourth toe (ZHAO et al. 1999). *G. taibaiensis* differs from *G. scientiadventura* by its significantly lower number of subdigital lamellae under the 4th toe and the series of preanal pores which is medially interrupted by a smooth scale. The specimens figured by SONG (1985) and HUANG & ZONG (1998) do not show a contrasting dorsal pattern as does *G. scientiadventura* sp. n.

There are only few species in the genus *Gekko* that have a lack of dorsal tubercles in common with *G. scientiadventura* sp. n. These are *G. athymus* Brown & Alcala, 1962, *G. subpalmatus* Günther, 1864, and *G. tawaensis* Okada, 1956.

G. athymus reaches a SVL of 100-120 mm, and has one internasal. Digits webbed for 1 third of their length. 19-

21 subdigital lamellae under 4th toe. Males with 22-23 preanal and femoral pores; subcaudals transversely broadened (BROWN & ALCALA 1962, 1978).



Fig. 11: Dorsal view of the holotype of *Gekko subpalmatus* (BMNH 1946.8.2592). Phot. T. ZIEGLER

G. subpalmatus reaches a SVL of 78 mm and has 1-2 internasals. Toes basally narrowly webbed. 7-10 subdigital lamellae under 4th toe. Males with 5-11 preanal pores. Subcaudals transversely broadened (GÜNTHER 1864; POPE 1935; ZHOU et al. 1989; ZHAO et al. 1999). For a better comparison with *G. scientiadventura* sp. n. we studied the holotype of *Gekko subpalmatus* (BMNH 1946.8.2592) and the lectotype and the paralectotype of *Gekko melli* Vogt, 1922 (ZMB 27659 A & B) which is considered to be synonymous with *G. subpalmatus* (e.g. ZHAO & ADLER 1993) (Figs. 11-13): The rostral of the holotype of *G. subpalmatus* has a short upper transverse suture, the posterior ciliaries are pointed, and there are five distinct tubercles anterior of the tympanum on the right side of the head. The dorsum is lilac-grey to violet-grey, a light postocular stripe and four longish grey-brown vertebral flecks are barely visible, and the tail has several broad light transverse bands that are bordered by darker pigment. The lectotype and the paralectotype of *G. melli* lack a rostral suture, the posterior ciliaries are likewise pointed, and pretympanic tubercles are lacking. The dorsum of ZMB 27659 A is olive-brown. There is a dark naso-ocular and a light postocular stripe. Two dark stripes are running from the ear openings to the axillae, and the shoulder region shows two sepia-coloured stripes. The dorsum has three broad, irregular and partly confluent, grey-brown bands with sepia-coloured margins, the tail has four broad pale brown bands that are likewise bordered by darker pigment. The regenerated tail tip has fine darker dots. Apart from their colour pattern, the types of both taxa differ also in size and in body proportions (SVL/TL index) and in the number of interorbitals, subdigital lamellae under the 4th toe, and scale rows in the third caudal whorl (see Tab. 3). Pending future studies on more material we consider *G. melli* therefore as valid.



Fig. 12: Portrait of the holotype of *Gekko subpalmatus* (BMNH 1946.8.2592). Phot. T. ZIEGLER



Fig. 13: Dorsal view of the lectotype of *Gekko melli* (ZMB 27659 A). Phot. H. RÖSLER

G. tawaensis reaches a SVL up to 70 mm and has internasals. The toes are basally narrowly webbed, and there are 12 subdigital lamellae under the 4th toe. The males have no preanofemoral pores, and the subcaudals are anteriorly mesially divided (OKADA 1956; SENGOKU 1989; UTSUNOMIYA et al. 1996).

G. scientiadventura sp. n. differs from the other *Gekko* species without dorsal tubercles by the combination of following characters: (a) SVL, (b) internasals, (c) extension of webbing between toes, (d) subdigital lamellae under 4th toe, (e) number of preanal pores, and (f) shape of subcaudals. *G. scientiadventura* sp. n. differs thus from *G. athymus* in the characters a, b, d, e; from *G. subpalmatus* in the characters a, b, c, d; and from *G. tawaensis* in the characters b, e, and f.

4. DISCUSSION

The genus *Gekko* Laurenti, 1768 contains, according to the last overview by KLUGE (2001) 28 species. We add to this number five more species which we consider as valid: *G. liboensis* Zhou & Li, 1982, *G. melli* Vogt, 1922, *G. mindorensis* Taylor, 1919 *G. scabridus* Liu & Zhou, 1982, and *G. scientiadventura* sp. n.

ZHAO & ADLER (1993) formally synonymize *G. liboensis* with *G. hokouensis*. KLUGE (1993), WELCH (1994), MATSUI & OTA (1995) and ZHAO et al. (1999) regard *G. hokouensis* as valid. It has 10 irregular rows of dorsal tubercles and 5-9 rows of preanal pores (ZHOU et al. 1989; ZHAO et al. 1999).

According to BAUER (1994) who refers to a personal communication by R. CROMBIE, *G. mindorensis* is a synonym of *G. kikuchii*. Both possess dorsal tubercles (TAYLOR 1919). However, *G. mindorensis* has more preanofemoral pores and longer limbs. Moreover, it has broad, medially divided, dark dorsal crossbands (FERNER et al. 2001; GAULKE 2003), whereas *G. kikuchii* has a double series of dark flecks on the dorsum (see the figs. in LU et al. 1999 and in HENKEL & SCHMIDT 2003).

ZHAO & ADLER (1993) formally synonymize *G. scabridus* with *G. chinensis*, whereas MATSUI & OTA (1995) and ZHAO et al. (1999) regard the former as valid. *G. scabridus* has 17-21 irregular, longitudinal rows of dorsal tubercles and 10-15 preanal pores (ZHOU et al. 1989).

The presence or lack of dorsal tubercles does not occur solely in the genus *Gekko*. Also other gekkonine genera, e.g. *Hemidactylus* Gray, 1825, and *Pachydactylus* Wiegmann, 1834, contain species with or without dorsal tubercles (SMITH 1935; FITZSIMONS 1943; LOVERIDGE 1947). The majority of *Gekko* species has these tubercles (SENGOKU 1989). Additionally, species-specific tubercles may also exist on the upper surfaces of head, limbs and tail. The tubercles may be rather big, as in *G. monarchus*, or very small, as in *G. ulikovskii*. Neither their relative size nor their complete absence are geographically correlated. Of the four tubercleless species, only *G. scientiadventura* sp. n., *G. melli* and *G. subpalmatus* are mainland species (Vietnam, southern China), whereas *G. tawaensis* is an endemic of Japan (southern Honshu and some small satellite islands) and *G. athymus* is an endemic of Palawan Island (Philippines).

Apart from the lack of dorsal tubercles, the four species have only few characters in common. The dorsal and tail pattern of *G. scientiadventura* sp. n. resembles most *G. tawaensis* (see fig. in UTSONOMIYA et al. 1996). Also in *G. subpalmatus*, the dorsal pattern consists of medially arranged light flecks, and the tail is banded (see fig. in ZHAO & ADLER 1993). The dorsal pattern of *G. athymus* consists of indistinct, broad, wavy bands (BROWN & ALCALA 1962). However, light vertebral areas or flecks/bands respectively occur more or less conspicuously also in other *Gekko* species (among else in *G. auriverrucosus*, *G. chinensis*, *G. hokouensis*, *G. japonicus*, *G. similignum*, *G. swinhonis*) so that closer relationships among the tubercleless *Gekko* species cannot be deduced from this character.

Phenotypically *G. scientiadventura* differs among the four tubercleless species most from *G. athymus* which is the geographically remotest (see above). From *G. tawaensis*, it differs by the anteriorly undivided subcaudals. Transversally widened (plesiotypic) versus divided (apotypic) subcaudals are not an exclusive character for *Gekko*, but are also common in the genera, e.g., *Lygodactylus* Gray, 1854 and *Phelsuma* Gray, 1825 (PASTEUR 1964; LOVERIDGE 1942).

A closer relationship of *G. scientiadventura* sp. n. to the two insular species *G. athymus* and *G. tawaensis* seems unlikely to us. Rather, our new species seems to be closer to *G. melli* and *G. subpalmatus* which has to be proven by future (molecular) studies. Both species, however, lack the striking spiny ciliary scales, and they have much broader webbings between the toes. *G. subpalmatus* differs strikingly from *G. scientiadventura* sp. n. by its uniform colour pattern (see figs. in ZHAO & ADLER 1993; HUANG & ZONG 1998). Less uniform is *G. melli*, but its dorsal bands are more roughly shaped as compared with the finely structured dorsal pattern of *G. scientiadventura* sp. n.

5. KEY TO THE GEKKO SPECIES OF VIETNAM

- | | | |
|----|---|--------------------------------------|
| 1 | Dorsal tubercles lacking | <i>Gekko scientiadventura</i> sp. n. |
| 1' | Dorsal tubercles present | 2 |
| 2 | SVL > 110 mm | <i>G. gecko</i> |
| 2' | SVL < 110 mm | 3 |
| 3 | Broad webbing between toes | 4 |
| 3' | Narrow webbing between toes | 5 |
| 4 | 1 Internasal, larger than nasorostrals | <i>G. chinensis</i> |
| 4' | 0-2 Internasals, smaller than nasorostrals .. | <i>G. palmatus</i> |
| 5 | Males with less than 10 preanal pores | <i>G. japonicus</i> |
| 5' | Males with more than 10 preanal pores | 6 |
| 6 | Dorsum with blotches | <i>G. grossmanni</i> |
| 6' | Dorsum with bands | 7 |
| 7 | 30-37 Interorbitals, southern Vietnam | <i>G. badenii</i> |
| 7' | 40-46 Interorbitals, central Vietnam | <i>G. ulikovskii</i> |

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Table 1: Measurements and proportions of *Gekko scientiadventura* sp. n. For abbreviations see Material and Methods, Section 2. * = holotype; ** = paratype; *** = live specimen.

	SVL	TL	HL	HW	HH	SE	EE	SVL : TL	SVL : HL	HL : HW	HL : HH	SE : EE
ZFMK 76174**	69.0	78.7	18.2	14.0	8.0	8.2	6.5	0.88	3.79	1.30	2.28	1.26
ZFMK 76175**	35.0	41.5	9.5	7.4	4.0	4.5	3.0	0.84	3.68	1.28	2.38	1.50
ZFMK 76176**	27.0	29.0	8.6	7.0	3.8	3.9	2.8	0.93	3.14	1.23	2.26	1.39
ZFMK 76177**	30.0	36.3	9.0	7.0	4.4	4.3	3.2	0.83	3.33	1.29	2.05	1.34
ZFMK 76178**	29.5	36.0	9.0	7.0	4.1	3.9	3.2	0.82	3.28	1.29	2.20	1.22
ZFMK 76179**	29.0	33.0	8.4	6.4	4.0	4.0	3.0	0.88	3.45	1.31	2.10	1.33
ZFMK 76198*	60.0	68.0	15.5	12.2	5.0	7.7	5.1	0.88	3.87	1.27	3.10	1.51
ZFMK 76199**	26.5	26.5	8.0	6.4	—	—	—	1.00	3.31	1.25	—	—
ZFMK 80651**	66.5	—	17.6	13.4	7.0	8.0	6.5	—	3.78	1.31	2.51	1.23
ZFMK 80652**	59.8	75.0	16.5	12.9	7.0	7.9	5.8	0.80	3.62	1.28	2.36	1.36
male***	70.0	75.0	19.5	15.0	8.5	9.0	7.0	0.93	3.59	1.30	2.29	1.29
female***	68.0	—	18.0	13.5	7.5	8.5	7.0	—	3.78	1.33	2.40	1.21
male***	66.0	70.0	19.0	14.0	8.0	8.5	7.0	0.94	3.47	1.36	2.38	1.21
male***	73.0	81.0	20.0	15.0	8.0	9.0	7.0	0.90	3.65	1.33	2.50	1.29

Table 2: Pholidosis of *Gekko scientiadventura* sp. n. For abbreviations see Material and Methods, Section 2. * = holotype; ** = paratype; *** = live specimen.

	SPL	SBL	N	IN	PM	GP	IO	V	SB	LT1	LT4	PP	PAT	S3R
ZFMK 76174**	13/13	13/12	3/3	0	2	5	41	38	139	12/14	14/14	0	3/3	10
ZFMK 76175**	13/12	9/9	3/3	0	2	6	—	48	118	14/12	17/16	0	3/3	10
ZFMK 76176**	14/13	11/11	3/3	0	2	6	—	43		13/14	15/17	0	—	10
ZFMK 76177**	14/14	9/9	3/3	0	2	5	—	40	133	14/-	15/-	0	—	11
ZFMK 76178**	13/14	9/9	3/3	0	2	5	—	43	136	13/15	17/-	0	—	
ZFMK 76179**	12/12	9/9	3/3	0	2	7	—	40	135	15/-	16/16	0	—	10
ZFMK 76198*	13/12	11/10	3/3	0	2	6	44	41	140	14/12	17/15	5	3/3	10
ZFMK 76199**	14/12	10/9	3/3	0	2	5	-			—	—	0	—	
ZFMK 80651**	—	11/11	3/3	—	2	6	42	43	131	14/14	15/14	0	2/2	11
ZFMK 80652**	12/13	10/9	3/3	0	2	6	49	42	133	15/15	17/16	0	2/2	10
male***	13	11	3	0	2	5	47	-	-	14	14	6	3	—
female***	14	12	3	0	2	7	48	-	-	14	16	0	3	—
male***	13	11	3	0	2	5	49	-	-	14	14	8	3	—
male***	14	11	3	0	2	5	51	-	-	14	14	6	3	—

Table 3: Measurements, proportions and pholidosis of *Gekko subpalmatus* (holotype BMNH 1946.8.2592, female) and *Gekko melli* (lectotype ZMB 27659 A, female; paralectotype ZMB 27659 B, juv.). For abbreviations see Material and Methods, Section 2.

	BMNH 1946.8.2592	ZMB 27659 A	ZMB 27659 B
SVL	55.0	84.6	29.0
TL	56.0	76.0*	26.5
HL	14.3	22.0	9.0
HW	11.0	15.8	6.6
HH	6.2	9.2	4.0
SE	7.1	9.3	4.0
EE	5.5	8.2	3.1
SVL : TL	0.98	1.11	1.09
SVL : HL	3.85	3.85	3.22
HL : HW	1.30	1.39	1.36
HL : HH	2.31	2.39	2.25
SE : EE	1.29	1.13	1.29
SPL	10/10	11/13	11/10
SBL	10/10	11/12	11/9
N	3/3	3/3	3/3
IN	1	1	1
PM	2	2	2
GP	5	4	6
IO	45	39	35
V	42	43	49
SB	148	147	158
LT1	12/11	11/11	11/10
LT4	10/10	14/12	14/13
PP	0	0	0
PAT	1/1	1/1	1/1
S3R	7	9	9

* 25.0 mm regenerated

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