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Short Note

Taxonomic Status of the Hong Kong Populations of the *Hemidactylus garnotii-vietnamensis* Complex (Gekkonidae: Reptilia)

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Hidetoshi Ota, Michael W. Lau and Anthony Bogadek (1995) Taxonomic status of the Hong Kong populations of the *Hemidactylus garnotii-vietnamensis* complex (Gekkonidae: Reptilia). *Zoological Studies* **34**(2): 126-130. Karyological investigations revealed that populations of the *Hemidactylus garnotii-vietnamensis* complex in Hong Kong have $2n = 3x = 63$ chromosomes, of which the two largest triplets consist of biarmed, and the third triplet of one subtelocentric and two telocentric chromosomes. This karyotype more or less differs from those of the two known members of the complex from Asia (i.e., *H. vietnamensis* and *H. stejnegeri*), and is almost identical to the karyotype of *H. garnotii* from the Pacific islands. Although there are slight external differences between the Hong Kong and Pacific islands specimens, it seems appropriate to identify the former as *H. garnotii* (*sensu stricto*).

Key words: *Hemidactylus garnotii*, Squamata, Cytotaxonomy, Hong Kong.

The fox gecko, *Hemidactylus garnotii* Duméril et Bibron *sensu lato*, is a moderate-sized lizard characterized by several features such as the relatively acute snout and distinctly flattened tail with lateral serrations. It is distributed in Southeast Asia, most tropical and subtropical islands of the Oceanian region, and the southeastern part of North America (Wermuth 1965, King and Krakauer 1966). After examining a large series of specimens from the Pacific area and Florida, Kluge and Eckardt (1969) confirmed the considerable rarity of males in this gecko, a situation that had been previously pointed out by Smith (1935) and Mertens (1960). Kluge and Eckardt (*op.cit.*) also reported that individuals from Hawaii and Florida had a karyotype consisting of an extremely large number (70) of chromosomes. Based on these observations, they assumed that this gecko is triploid and parthenogenetic in reality. Several recent authors, while confirming their assumptions regarding the ploidy and the mode of reproduction in this lizard, demonstrated that *H. garnotii* (*sensu lato*) is actually an assemblage of at least three unisexual species – *H. garnotii* (*sensu stricto*), *H. vietnamesis* Darevsky et Kupriyanova in Darevsky et al. (1984), and *H. stejnegeri* Ota et Hikida, 1989. These species are chromosomally distinctly differentiated from each other, but are rather poorly diversified externally (Darevsky et al. 1984, Ota and Hikida 1989). It is almost impossible at present to definitely discriminate these species based solely on morphological characters. Therefore, quite a few populations, including those in China (exclusive of Taiwan), from which karyotypic data are not yet available remain referable merely as members of the *H. garnotii-vietnamensis* complex (Ota and Hikida 1989, Ota et al. 1986).

In the present study, we have examined specimens of this complex from Hong Kong karyologically and morphologically. Results indicate that they belong to *H. garnotii* (*sensu stricto*) as described below.

Materials and Methods—A total of eight specimens, all females, were collected in Hong Kong (two from Sha Lo Tung, New Territories; two from Shek Pik, Lantau Island; two from Aberdeen Catchment, Hong Kong Island, and two from Yim Tin Tsai Island: Fig. 1), and were brought to the laboratory of the first author where they were karyotyped. The geckos were injected intraperitoneally with 0.1 ml of colchicine solution (2 mg/ml) per gram body weight, 12 hr before sacrifice. Bone marrow cells were extracted from the femur and were treated with 0.06 M hypotonic KCl for approximately 40 min, followed by rinsing and fixation in a 1:3 solution of glacial acetic acid and absolute methyl alcohol. Mitotic metaphase cells were spread on slides by an air-dry method and were stained in 2% Giemsa solution for detailed study of chromosomes. The karyotype was determined from at least five well-spread cells for each individual. Terminology for the description of chromosomes follows Green et al. (1980).

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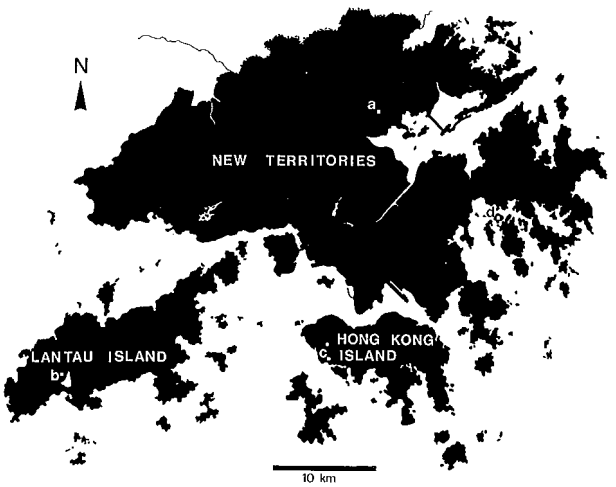

Fig. 1. Map of Hong Kong showing the sampling localities of the specimens examined in the present study. a, Sha Lo Tung ($N=2$); b, Shek Pik ($N=2$); c, Aberdeen Catchment ($N=2$); d, Yim Tin Tsai Island ($N=2$).

The specimens were also examined morphologically after fixation in 10% neutral formalin and preservation in 70% ethanol. Definitions of meristic characters and measurements follow Ota and Hikida (1989). Catalogue numbers of specimens deposited at the Department of Zoology, Kyoto University, are preceded by KUZ. The other institutional acronyms are those suggested by Leviton et al. (1985).

Results—Figure 2 presents the general appearance of specimens from Hong Kong. Meristic data for all specimens are summarized in Table 1.

Head and body strongly depressed; snout-vent length (SVL) 50.6–58.7 ($\bar{x}=54.4$) mm for six adults, 42.7–44.1 mm for two juveniles; distance between snout and forelimb insertion 37.3–42.3 ($\bar{x}=40.3$) % of SVL; head length (HL) 26.3–28.6 ($\bar{x}=27.5$) % of SVL, head width 61.5–68.6 ($\bar{x}=64.8$) % of HL, head depth 32.0–34.8 ($\bar{x}=33.2$) % of HL; snout much elongated, acutely tapering, but rounded at tip, its length 44.3–49.3 ($\bar{x}=47.4$) % of HL; eye length 21.7–27.3 ($\bar{x}=24.6$) % of HL, eye to ear distance 24.0–28.7 ($\bar{x}=26.4$) % of HL; internasal distance 9.8–12.0 ($\bar{x}=11.3$) % of HL, interorbital distance 32.2–37.1 ($\bar{x}=34.7$) % of HL; rostral quadrangular, about one and a half to two times as wide as high, posterior half with shallow groove dorsomedially; nostril surrounded by first su-

Table 1. Meristic data ($\bar{x}$, followed by ranged in parentheses) of *Hemidactylus garnotii* and *H. vietnamensis*

	H. garnotii				*H. vietnamensis*
	Hong Kong ($N=8$)	Hawaii ($N=10$)	Fiji ($N=6$)	Florida ($N=2$)	($N=4$)
ISPM	16.25 (13–20)	9.41 (7–12)	10.80 (8–14)	8.50 (7–10)	14.00 (7–17)
LPS	5.63 (4–7)	8.83 (6–15)	8.74 (6–10)	6.00 (4–8)	5.50 (4–8)
SL	14.88 (14–16)	15.50 (14–17)	16.71 (16–18)	15.00 (13–17)	15.75 (14–17)
IL	10.50 (9–13)	11.92 (10–14)	13.33 (12–14)	12.00 (11–13)	11.25 (10–12)
IFS	5.88 (5–6)	6.60 (5–7)	6.72 (6–7)	6.50 (6–7)	5.75 (5–6)
FFS	10.25 (10–11)	11.94 (11–13)	12.23 (11–13)	11.00 (–)	10.50 (10–11)
ITS	6.00 (–)	6.71 (6–7)	7.00 (–)	6.50 (6–7)	6.00 (–)
FTS	12.63 (12–13)	14.53 (14–16)	14.33 (14–15)	14.50 (14–15)	13.00 (12–14)

Abbreviations are: ISPM, interprimary and intersecondary postmental scales; LPS, lateral postmental scales; SL, supralabials; IL, infralabials; IFS, first finger scansors; FFS, fourth finger scansors; ITS, first toe scansors; and FTS, fourth toe scansors.

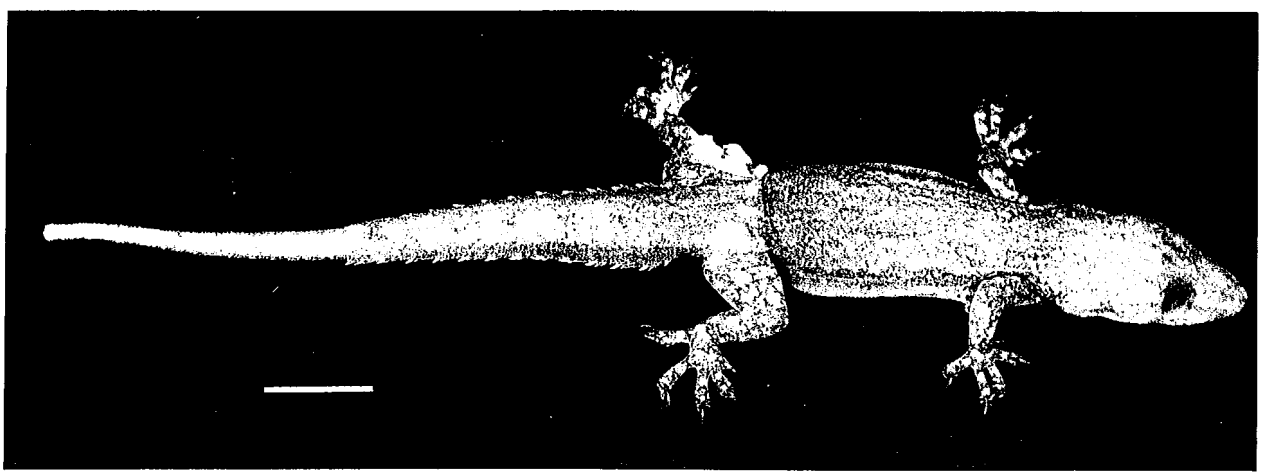

Fig. 2. Dorsolateral view of a specimen of *Hemidactylus garnotii* from Hong Kong (KUZ 21622). Bar equals 10 mm.

pralabial, rostral, supranasal, and two small scales posteriorly; supranasals separated by two scales in a longitudinal row, anterior one bordering rostral; supra- and infralabials reducing in size posteriorly, those beneath posterior margin of eye almost as large as adjacent scales; mental triangular, much larger than adjacent labials; two rows of enlarged postmentals, anterior pair in contact with each other and first infralabials, posterior pair separated both from each other and labial series by small intervening scales in six specimens, contacting second infralabials in two specimens; interprimary postmentals lacking; scales on snout somewhat enlarged compared with those on dorsal surface of body.

Axilla-groin length 43.8–53.2 ($\bar{x}$ = 48.6) % of SVL; scales on dorsal and lateral surfaces very small, granular; a few slightly enlarged tubercles in dorsolateral region just before groin, tubercles lacking in the other parts; ventral scales much larger, flat, and lozenge-shaped.

Limbs well developed; digits long, moderately dilated, length of dilated portion of fourth toe 8.9–10.9 ($\bar{x}$ = 10.0) % of SVL, its width 29.1–34.7 ($\bar{x}$ = 32.0) % of length; all digits bearing scansors on the whole length of their ventral surfaces, six on first toe, 11 on third toe, 12–13 ($\bar{x}$ = 12.6) on fourth toe; four to eight subterminal scansors slightly to deeply notched, the others including terminal one entire; all digits including the first clawed; distal, compressed claw-bearing phalanges arising within and extending beyond dilated portion; webs absent between first and second digits, and only barely evident (extending to less than one-sixth of digits) between third and fourth digits; three or four rows of slightly enlarged preanal and femoral scales extending almost to distal end of thigh; pores lacking, but indistinct hollows appearing on some scales in proximal half of thigh; cutaneous fold lacking in axilla-groin region or posterior border of hind limb; cloacal spur lacking; tail much depressed, with distinct lateral serrations, but without cutaneous flanges; subcaudal region covered with a longitudinal row of scute-like scales, much wider than long.

In life, dorsal ground color grayish-tan to dark gray, with light cream-white spots scattered on body and limbs; eight to twelve indistinct, light transverse bands on tail. Ventral surface of head, body, and most of limbs light yellow; subdigital region gray, distinctly darker on margin of each scansor; ventral surface of tail creamy yellow in six specimens, slightly reddish in two specimens. After preservation, dorsal ground color faded to paler, making the light spots and bands more indistinct, and ventral color faded to cream white.

All specimens had a karyotype consisting of $2n = 3x = 63$ chromosomes (Fig. 3A). Of these, the six largest chromosomes, forming the first two triplets, were biarmed. The first triplet was highly heterogeneous both in size and shape of its elements: one of its three components was slightly larger than the remainders and was almost completely metacentric, whereas one of the others was distinctly submetacentric. The second triplet seemed more homologous excepting that one of the three elements appeared slightly submetacentric and smaller in size in comparison with the others. The third triplet was strikingly heterogeneous (Fig. 3B). One of the three chromosomes forming this triplet was subtelocentric whereas the remainders were telocentric. Moreover, one of the telocentric chromosomes exhibited achromatic gaps, indicating the presence of secondary constrictions, near the centromere. Secondary constrictions might also occur on the subtelocentric chromosomes in a few cells (Fig. 3A), but was not sufficiently evident in this study (Fig. 3B). The remaining 18 triplets consist of telocentric chromosomes in a graded series. There were no recognizable heterogeneities in any of these triplets.

Discussion—Kluge and Eckardt (1969) reported that *H. garnotii* from Hawaii and Florida had $2n = 3x = 70$ chromosomes including six large biarmed and 64 uniarmed elements forming a continuous size grade. They also demonstrated the heterogeneity in the first two (biarmed) and the third (uniarmed) triplets expressed by the differences in size and centromeric position, and the condition of secondary constrictions, respectively. Recently, however, Moritz et al. (1993) reported that karyotypes of specimens from French Polynesia (type locality of *H. garnotii*), as well as from Hawaii and Fiji, had $2n = 3x = 63$ chromosomes, whereas one animal from Florida had 65 chromosomes. Judging from text descriptions and figures of Kluge and Eckardt (1969) and Moritz et al. (1993), it is highly likely that the inconsistency in the chromosome number between karyotypes reported by these authors, as well as between those of Pacific and Florida specimens by Moritz et al. (*op. cit.*), is attributable to the numerical difference in microchromosomes. Further surveys are needed to see whether these differences reflect actual clonal diversification within *H. garnotii* or are mere products of miscounting of the microchromosomes.

Karyotypes of the specimens from Hong Kong seem to be almost identical with those of Pacific island specimens described by Moritz et al. (1993), and this strongly suggests that the Hong Kong populations belong to *H. garnotii* (*sensu stricto*). Even so, however, the presence of short arms in one of the third triplet components is not evident in the latter karyotype or the karyotype described by Kluge and Eckardt (1969). This and other characters of the nine large chromosomes of the Hong Kong specimens seem to be shared more exactly with those of *H. vietnamensis* from Vietnam described by Darevsky et al. (1984). The only recognizable chromosomal difference between the Hong Kong population of *H. garnotii* and *H. vietnamensis* is the total chromosome number (63 vs 60), which seems to be attributable to a slight numerical change in microchromosomes.

Darevsky et al. (1984) compared meristic characters of *H. vietnamensis* with those of *H. garnotii* taken from Kluge and Eckardt (1969), and stated that the former is morphologically differentiated from the latter in having significantly smaller numbers of lateral postmental scales, supralabials,

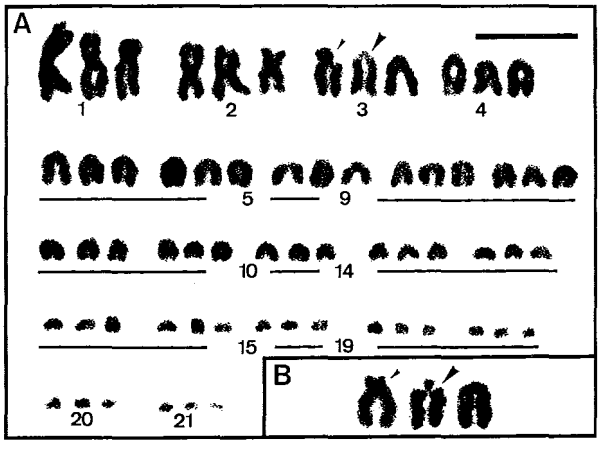

Fig. 3. The standard karyotype of *Hemidactylus garnotii* from Hong Kong (A), and the third triplet from another cell (B). Small and large arrows indicate the short arm of the subtelocentric chromosome and secondary constrictions of the telocentric chromosome of the third triplet, respectively. Bar equals 10 μm.

infralabials, first toe scansors, and fourth toe scansors. They also noted that specimens from Burma and Tonkin, which they had examined directly, shared those character states with *H. vietnamensis*. Darevsky et al. (1984) thus speculated that *H. vietnamensis* also occurs in India, Indo-China, and southern China. However, our results of direct comparisons between *H. vietnamensis* and *H. garnotii* from several localities suggest that there are actually no recognizable interspecific differences in labial counts ($p > 0.05$: Wilcoxon's 2-sample test). The numbers of lateral postmental scales and subdigital scansors surely differed significantly between *H. vietnamensis* and the Hawaiian or Fijian specimens of *H. garnotii* ($p < 0.05$ or 0.01). These characters, however, did not differ between the former and the Hong Kong specimens of *H. garnotii* (Table 1).

Results of chromosomal and morphological comparisons indicate that *H. garnotii* and *H. vietnamensis* are even more closely related to each other than was assumed previously (Darevsky et al. 1984, Ota and Hikida 1989), and that they cannot be statistically differentiated from each other on the basis of a single morphological character. It is likely that the statistical meristic differences assumed between the two species by Darevsky et al. (*op. cit.*) actually emerged within *H. garnotii* probably during the process of its dispersal over the Pacific region (Moritz et al. 1993).

Specimens examined: *Hemidactylus garnotii*.- Hong Kong: KUZ 21618-21622, 21780-21781, 21798. Hawaii: AMNH 22341, FMNH 3511, 42999-43000, 43002, 43690-43691, MCZ 20270-20271, 20273. Fiji: AMNH 81734-81738, 81744. Florida: AMNH 115774, MCZ 77585. *H. vietnamensis*.- Vietnam: ZIL 19803-19804 (paratypes) and two uncatalogued specimens.

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香港產鋸尾蝎虎種群(*Hemidactylus garnotii–vietnamensis* complex)(壁虎科：爬行綱)之分類地位

太田英利[1]　劉惠寧[2]　鮑嘉天[3]

一項核型學的研究發現在香港的鋸尾蝎虎種群具有$2n=3x=63$的染色體，其中最大的兩個三聯體是由二臂染色體組成，第三個三聯體則由一條亞末端終節染色體及兩條末端終節染色體組成。這種染色體組型不同於這個種群在亞洲的已知兩種(即*H. vietnamensis*和*H. stejnegeri*)，卻和太平洋島嶼上的鋸尾蝎虎*H. garnotii*幾乎相同，雖然香港和太平洋島嶼的標本在外貌上有些微分別，將前者鑒定爲鋸尾蝎虎*H. garnotii* (*sensu stricto*)亦爲恰當。

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