Karyotype of *Gekko monarchus* (Squamata: Gekkonidae) from Sarawak, Malaysia

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Abstract: *Gekko monarchus* from Sarawak, Malaysia, has $2n=44$ chromosomes forming a graded series, of which all but one submetacentric pair of micro-elements are unarmed. The relationship of *G. monarchus* with other congeneric species is discussed from a cytotaxonomic point of view.

Key words: *Gekko monarchus*; Gekkonidae; Karyotype; Sarawak; Malaysia

The genus *Gekko* consists of nearly 30, morphologically highly diverse species distributed in East and Southeast Asia, the Indo-Australian Archipelago, and the western Pacific islands (Wermuth, 1965; Zhou et al., 1982; Song, 1985; Ota, 1989a; Shibata, 1989, 1990; Ota and Nabhitabhata, 1991; Ota et al., 1991). Ota (1989b), in describing karyotypes of five *Gekko* species, briefly reviewed the published chromosome data for species belonging to this genus and demonstrated extensive intrageneric karyological diversifications involving changes in both diploid and fundamental numbers. Yet, karyotypes of nearly two thirds of the species in the genus remain unknown, and therefore, it is strongly desirable to accumulate data for such "unsurveyed" species to clarify the relationships among *Gekko* species from a cytotaxonomic viewpoint.

In the present study, we investigated *G. monarchus* karyologically for the first time, and compared its karyotype with those of other congeneric species hitherto karyotyped. Results indicate a close chromosomal resemblance between *G. monarchus* and *G. kikuchii*, a species endemic to Lanyu Island, Taiwan (Ota, 1989a).

MATERIALS AND METHODS

Two males and two females of *G. monarchus*, all collected from Kuching and Sibul, Sarawak, Malaysia, were used. Metaphase preparations were made by a bone-marrow air-dry method following Ota et al. (1987). Each slide was investigated after being stained in 3% Giemsa solution for 30 min. The karyotype was determined for each animal on the basis of at least 10 well-spread cells. Voucher specimens were deposited in the herpetological collection of the Department of Zoology, Kyoto University (KUZ 12317, 12401, 12407, 12495).

RESULTS AND DISCUSSION

G. monarchus has a karyotype consisting of $2n=44$ chromosomes. Of these, the second smallest pair is submetacentric, and all the others are acrocentric elements. Thus, the fundamental number (NF) was calculated as 46. No size-group formations nor sex chromosome heteromorphisms were evident (Fig. 1).

Published chromosome data for species belonging to the genus *Gekko* are summarized in Table 1. Diploid chromosome numbers in most karyotyped members of this genus are 38, and only two species, *G. kikuchii* from Lanyu Island, Taiwan, and *G. sp.* from Thailand, are exceptions by having $2n=44$ and 42 chromosomes, respectively. Karyomorphs with $2n=38$ chromosomes are also characterized by the presence of two large metacentric pairs that are distinct in size from the remaining pairs. On the other hand, no such enlarged metacentric pairs or size group formations are recognized in the karyotypes of *G. kikuchii* and *G. sp.* from Thailand (Ota, 1989b; Ota and Nabhitabhata, 1991).

The diploid number of *G. monarchus* is identical with that of *G. kikuchii*, and is greater than those of other species. Moreover, karyotypes of the two species, as well as that of *G. sp.* from Thailand, greatly resemble each other in the absence of enlarged metacentric pairs which results in the formation of a graded chromosome series. The NF value of *G. monarchus* (46) is smaller than any other congeneric species. In this feature, the karyotype of this species most closely resembles those of *G. gecko*, *G. smithii* and *G. sp.* from Thailand (NF=48), and then, *G. kikuchii* (NF=50).

Several authors, studying the mode of chromosomal differentiation and evolution in geckos, postulated centric fusion (involving a change in chromosome number, and the conser-

TABLE 1 The diploid (2n) and fundamental numbers (NF) in the known karyotypes of species of *Gekko*.

Species	2n	NF	Sources
<i>G. monarchus</i>	44	46	This study
<i>G. gecko</i>	38	48	Cohen et al. (1967), Wu and Zhao (1984), Solleder and Schmid (1984)
<i>G. hokouensis</i>	38	56	Chen et al. (1986)
<i>G. japonicus</i>	38	58	Yoshida and Itoh (1974), Chen et al. (1986)
<i>G. kikuchii</i>	44	50	Ota (1989b)
<i>G. petricolus</i>	38	54	Ota (1989b)
<i>G. smithii</i>	38	48	Ota (1989b)
<i>G. subpalmatus</i>	38	58	Wu and Zhao (1984)
<i>G. swinhonis</i>	38	66	Chen et al. (1986)
<i>G. tawaensis</i>	38	56	Ota (1989b)
<i>G. yakuensis</i>	38	56	Ota (1989b)
<i>G. sp.</i>	42	48	Ota and Nabhitabhata (1991)*

* Ota (1989b) reported the karyotype of this form from Thailand as that of *G. smithii*. But in reality, it turns out to represent a good species by a subsequent comparative study by Ota and Nabhitabhata (1991).

vation of NF value) and pericentric inversion (vice versa) to be major patterns of chromosomal re-organization in this group [see King (1987a, b) for review]. In the genus *Gekko*, the chromosome number is relatively conservative, whereas the NF value is variable. Ota (1989b), therefore, assumed the predominance of pericentric inversion over fusion in the karyological diversification within this genus. Accepting this assumption, the karyotype of *G. monarchus* seems to be evolutionally most closely allied to that of *G. kikuchii*. Close morphological resemblance bet-

ween the two species (Ota, unpublished data) supports this speculation.

ACKNOWLEDGMENTS.—We wish to express our sincere thanks to T. Hidaka for providing an opportunity to visit Sarawak. We are also deeply grateful to K. Araya and T. Ueda for their help, and to David Labang, Abang Abdul Hamid and the staff of the National Park & Wildlife and Forest Research Sections, Forest Department of Sarawak, for continuous support during our survey in Sarawak. We thank J. A Wilkinson for correcting verbal errors. Field trips of Hikida, Matsui and Mori were supported by a Monbusho International Scientific Research Program

FIG. 1. Karyotype of *Gekko monarchus* from Kuching, Sarawak, Malaysia (female, KUZ 12495). The bar equals 10 μ m.

(Field Research: No. 01041051) to T. Hidaka. Ota's laboratory work was partially supported also by a Grant-in-Aid from the Japan Ministry of Education, Science and Culture (A-63790257).

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要 旨 マレーシア、サラワク州産ヤモリの一種 (*Gekko monarchus*) の核型

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マレーシア、サラワク州で採集された *Gekko monarchus* は大きさの連続する $2n=44$ 本の染色体を持っていた。その形態は、次端部動原体型の微小染色体一組を除き、すべて単腕型であった。*Gekko monarchus* と他の同属種との類

縁関係について、細胞分類学の立場から論じた。

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