Title

Studies on the Small Mammal Fauna of Sabah, East Malaysia

II. Karyological Analysis of Some Sabahan Mammals (Primates, Rodentia, Chiroptera)

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II. Karyological Analysis of Some Sabahan Mammals (Primates, Rodentia, Chiroptera)\(^1\)

Masashi Harada and Tsuneaki Kobayashi

Abstract

Karyotypes of the following 18 small mammal species from Sabah, East Malaysia, have been analysed. The material includes one tree-shrew (*Tupaia montana*), 4 rodents (*Rattus rattus*, *Mus musculus*, *Sundasciurus jentinki*, *Callosciurus albosece*), and 13 bats (*Pteropus vampyrus*, *Cynopterus brachyotis*, *Aethalops aleco*, *Emballonura rivalis*, *Rhinolophus creagi*, *Hipposideros diadema*, *Hipposideros galactius labuanensis*, *Tadarida plicata*, *Myotis horsfieldi*, *Scotophilus temmincki*, *Miniopterus schreibersi*, *Miniopterus magnater*, *Miniopterus australis*).

The results were given in Table 2. Karyotypes of 12 species in this paper are described for the first time. All the present data were compared with the respective data hitherto available to the authors, and some discussions were tried on their phylogenetical implications.

Introduction

In these ten years, mammalian cytogenetics has had some remarkable advances which nearly caused the classic karyotyping method and results to become obsolete ones in the cytogenetic field of biology, but there remains only few karyological knowledge of Bornean fauna which has been comprised by great number of animal species.

Present report treats 18 species of small mammals from Sabah, of which some species are the first time to report its karyotype, and try to compare them with known karyological data to each related datum.

As a rule, cytogenetic findings confirm taxonomists’ contention regarding species relationships in many cases. The authors hope that the present paper will also contribute to systematics of Sabahan mammals in some regards.

The fieldwork was fully funded by the “Overseas Scientific Research Grant” delivered from the Ministry of Education of Japan.

During our field-works in Sabah, following gentlemen extended their heartfelt support. The authors must express their sincere thanks to them.

Senior Research Officer Mr. Liew That Chin, Forest Research Center, Mr. Francis Liu, Park Warden of the Kinabalu National Park, and Professor Dr. Ryozo Yoshii, Entomologist of Sabah Forest Research Center and former Organizer of this project, gave us pertinent suggestions for the project. We thank Mr. Michihiro Yosida of Sandakan, is particularly acknowledged for hospitality and co-operation for arrang-

\(^1\) Contribution from the “Kyoto University Biological Expedition to the Malesian Tropical Rain Forest” No. 5.
Mr. Raymund Goh, Assistant Curator of Sabah Museum, who had followed up whole collection works and gave valuable advices on localities where suitable specimens can collect to the authors. Mr. Saike Lentoh, Assistant Researcher of F.R.C., and other pearsons sent by F.R.C. also freindly covered our distressed job in the field.

Drs. Toshitaka Hidaka, Sumiko Matsumura and Mr. Yoshihiro Tempo provided valuable company and support during the fieldwork.

The authors’ sincere thanks are also due to the Oska City University Medical School, for granting leaves of his valuable collegue for participation in overseas survey.

**Materials and Methods**

The materials used in the present studies are 18 species from Sabah, Borneo. Identification of these mammals is refered to Harrison (1964) and Medway (1969).

Table 1. The materials used in the present study; their names of species and localities of collection.

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of specimens examined</th>
<th>Localities of collection</th>
</tr>
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<td><em>M. australis</em></td>
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The detailed localities of these samples and the number of individuals examined are summarized in Table 1.

Some mammals to be sacrificed were injected with 0.1 ml to 0.5 ml of 0.05% (W/V) colchicine into the peritoneal cavity and killed one hour later. Bone marrow cells of the femur or the humerus were treated with hypotonic solution (0.08% Sodium Citrate) for 15 min at room temperature, fixed in methanol-acetic (1:1) and air-drying. Tissues of lung of the others were cultured by us in the technique described previously (Harada and Yosida, 1978). 20 or more metaphase spreads were counted to determine the diploid number of each specimen. The chromosome were classified according to Levan et al. (1964). Fundamental number (FN) was defined from the number of autosomal arms.

**Results and Discussion**

1. **Primates**

*Tupaia montana* (Fig. 1a)

The chromosome number is $2n=68$ and consist of one meta-submetacentric pair, two subtelocentric pairs, 30 acrocentric pairs ranging from medium to small, a medium sized submetacentric X and a small acrocentric Y chromosome. This karyotype of *Tupaia montana* is indistinguishable from that of *T. montana* observed by Arrighi et al. (1969).

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<tr>
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<th>2n</th>
<th>FN</th>
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<th>X</th>
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<td>S T</td>
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<td></td>
<td>38</td>
<td>S M</td>
<td>A</td>
</tr>
</tbody>
</table>
2. Rodentia

*Rattus rattus* (Fig. 1b)

The chromosome number of this species is 2n=42. The karyotype consist of 7 meta-submetacentric pairs, 13 acrocentric or subtelocentric autosomal pairs, and an acrocentric X and Y. Among them, pairs no. 1, 9 and 13 is characterized by acrocentric and subtelocentric polymorphism (Yosida et al., 1965, 1971, 1976). In the present analysis, all black rats showed the ST/ST homomorphy in no. 1 pair. The

Fig. 1. Karyotypes of three species from Sabah.  

a, *Tupaia montana* 2n=68.  
b, *Rattus rattus* 2n=42.  
c, *Mus musculus* 2n=40.
no. 9 chromosome pair is A/A homomorphy in two rats, ST/ST homomorphy in one. The no. 13 chromosome pair is S/A heteromorphy in one, S/S homomorphy in 2 rats.

One of these specimens had 43 chromosome consisting of one set of normal diploid chromosome complement plus a supernumerary small metacentric chromosome (Fig. 1b, B). The presence of supernumerary chromosomes has been reported widely in the black rats (Gropp et al., 1970, Yong and Dhaliwal, 1972, Raman and Sharma, 1974, Yosida and Sagai, 1975, Yosida, 1977).

Mus musculus (Fig. 1c)

The chromosome number of this species is 2n = 40 and consist of a graded series of

![Karyotypes of three species from Sabah.](image)

Fig. 2. Karyotypes of three species from Sabah. Arrow indicates pair of chromosomes with secondary constriction. a, Sundasciurus jentinki 2n = 38. b, Callosciurus albecens 2n = 38. c, Pieropus vampyrus 2n = 38.
19 acrocentric pairs, and acrocentric X and Y chromosome.

*Sundasciurus jentinki* (Fig. 2a)

The chromosome number is $2n=38$ and consist of 12 meta-submetacentric, 3 subtelocentric pairs, one acrocentric pair, a submetacentric X and an acrocentric Y chromosome.

*Callosciurus albensens* (Fig. 2b)

The chromosome number is $2n=38$ and consist of a submetacentric X and an acrocentric Y. As the present chromosome preparation is not in good condition, the autosomal complement and the fundamental number were not determined.

3. Chiroptera

*Pteropus vampyrus* (Fig. 2c)

The chromosome number is $2n=38$ and consist of 8 pairs of metacentric, 9 pairs of submetacentric, one pair of subtelocentric, a medium sized submetacentric X and a dot-like acrocentric Y chromosome. One pair of medium sized submetacentric chromosome possesses a secondary constriction.

Karyotype described here is similar to those of *P. dasmhallus inopinatus*, *P. pselaphon* (Tsuchiya, 1979), *P. giganteus giganteus* (Pathak, 1965, Bhatnagar and Srivastava, 1974), and *P. poliocephalus* (Bogart et al., 1977). Although species of *Pteropus* demonstrate considerable diversity and morphological variation in general, the chromosomal morphology as revealed by conventional uniform staining indicates that the karyotype of this genus is said as strictly conservative.

*Cynopterus brachyotis* (Fig. 3a)

The chromosome number is $2n=34$ and consist of 12 meta-submetacentric pairs, two subtelocentric pairs and three acrocentric pairs.

As males were not examined, the sex chromosome and the fundamental number were not determined. One medium sized submetacentric pair possesses a prominent secondary constriction. The chromosomal morphology of *C. brachyotis* is very similar to those of *C. sphinx sphinx* (Pathak, 1972) and *C. sphinx gangeticus* (Pathak, 1965).

*Aethalops alecto* (Fig. 3b)

The chromosome number is $2n=34$ and consist of 10 meta-submetacentric pairs, 7 acrocentric pairs. As male were not examined, the sex chromosomes were not determined. One pair of large sized submetacentric chromosome also possesses a secondary constriction.

Presence of this maker chromosome pair in the karyotype of other Megachiropteran species, e.g., *Cynopterus sphinx sphinx*, *C. sphinx gangeticus*, *C. brachyotis*, *Pteropus giganteus giganteus*, *P. dasmhallus inopinatus*, *P. pselaphon*, *Rousettus leschenaulti*, *P. poliocephalus* may have been indicated their close evolutionary relationships.
Emballonura rivalis (Fig. 3c)
The chromosome number is 2n=24 and consist of 11 meta-submetacentric pairs, a medium sized submetacentric X and a small acrocentric Y chromosome.

Rhinolophus creaghi (Fig. 4a)
The chromosome number is 2n=62 and consist of 30 acrocentric pairs ranging from medium to small, a subtelocentric X and a small subtelocentric Y chromosome. The karyotype of R. creaghi is identical with that of R. cornatus (Tsuchiya, 1971, Harada, 1973, Ando and Uchida, 1974).

One pair of acrocentric chromosome has secondary constriction adjacent to the centromere. This maker chromosome also appear in Rhinolophus hildebrandti (Peterson and Nagorsen, 1975), R. darlingi (Peterson and Nagorsen, 1975), R. denti (Peterson

Fig. 3. Karyotypes of three species from Sabah. Arrows indicate pairs of chromosomes with secondary constrictions. a, Cynopterus brachyotis 2n=34. b, Aethalops alecto 2n=34. c, Emballonura rivalis 2n=24.

_Hipposideros diadema_ (Fig. 4b)

The chromosome number is 2n = 32 and consist of 15 meta-submetacentric pairs, a medium sized submetacentric X and a small sized subtelocentric Y chromosome.

_Hipposideros galeritus labuanensis_ (Fig. 4c)

The chromosome number is 2n = 32 and consist of 11 meta-submetacentric pairs, 4 subtelocentric pairs, a large submetacentric X and a small acrocentric Y chromosome.

Fig. 4. Karyotypes of three species from Sabah. Arrow indicates pair of chromosomes with secondary constriction. a, Rhinolophus creaghi 2n = 62. b, Hipposideros diadema 2n = 32. c, Hipposideros galeritus labuanensis 2n = 32.

The karyotype of these species and *H. diadema* in this paper differ in the position of the centromere of the largest chromosome pair and in 4 pairs of medium to small sized chromosome, these might have resulted from pericentric inversions.

*Tadarida plicata* (Fig. 5a)

The chromosome number is 2n=48 and consist of four meta-submetacentric pairs, 19 acrocentric pairs ranging from medium to small, a medium sized submetacentric X and a small acrocentric Y chromosome. Some acrocentrics appear to have small secondary arms.

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![Karyotypes](image)

**Fig. 5.** Karyotypes of three species from Sabah. Arrow indicates pair of chromosomes with secondary constriction. a, *Tadarida plicata* 2n=48. b, *Myotis horsfieldi* 2n=44. c, *Scotophilus temmincki* 2n=36.
Karyotype of present *T. plicata* is similar to those of *T. plicata* from Thailand (Tsuchiya et al., 1979), *T. bivittata, T. fulminans* from Africa (Peterson and Nagorsen, 1975) and *T. laticaudata, T. femorosacca, T. brasiliensis, Eumops underwoodi, Tromops davisoni* from America (Warner et al., 1974).

*Myotis horsfieldi* (Fig. 5b)

The chromosome number is 2n=44 and consist of three large meta-submetacentric pairs, one small meta-submetacentric pair, 17 acrocentric pairs ranging from medium to small, a medium sized submetacentric X and a small acrocentric Y chromosome.

The morphological difference of chromosome no. 5 in genus *Myotis* have been previously reported in Japanese *Myotis* (Harada and Yosida, 1978). The chromosome

![Karyotypes of three species from Sabah](image)

Fig. 6. Karyotypes of three species from Sabah. Arrows indicate pairs of chromosomes with secondary constrictions. a, *Miniopterus schreibersi* 2n=46. b, *Miniopterus magnater* 2n=46. c, *Miniopterus australis* 2n=46.
no. 5 of this species is probably identical to the minute acrocentric chromosome of the standard karyotype.

*Scotophilus temmincki* (Fig. 5c)

The chromosome number is $2n=36$ and consist of 6 meta-submetacentric pairs, one subtelocentric pair, 10 acrocentric pairs, a medium sized submetacentric X and a small acrocentric Y chromosome. The smallest acrocentric pair has secondary constriction.

Karyotype of this species is similar to those of *S. kuhli* (Pathak and Sharma, 1969), *S. temmincki wroughtoni* (Pathak and Sharma, 1969), *S. heathi* (Bhatnagar and Srivastava, 1974) and *S. nigrita* (Peterson and Nagorson, 1975).

*Miniopterus schreibersi* (Fig. 6a)

The chromosome number is $2n=46$ and consist of two large meta-submetacentric pairs, one small meta-submetacentric pair, 19 acrocentric pairs ranging from medium to small, a medium sized submetacentric X and a small acrocentric Y chromosome. One small acrocentric pair has secondary constriction adjacent to the centromere.

*Miniopterus magnater* (Fig. 6b)

The karyotype appears to be identical with that of *M. schreibersi*, and autosomes consist of two pairs of large meta-submetacentric, one small meta-submetacentric pair, and 19 acrocentric pairs. Sex chromosome consist of a submetacentric X and a small acrocentric Y chromosome. An acrocentric with secondary constriction is also present in the karyotype of this species.

*Miniopterus australis* (Fig. 6c)

The chromosome number is $2n=46$ and karyotype of this species is similar to *M. schreibersi* and *M. magnater*, with two large meta-submetacentric pairs, one small meta-submetacentric pair, 19 acrocentric pairs ranging from medium to small, a submetacentric X and an acrocentric Y chromosome.

Karyotypic data given here *M. schreibersi*, *M. magnater*, and *M. australis* are remarkably similar to those of *M. schreibersi pallidus* (Vorontsov et al., 1969) and *M. schreibersi fuliginosus* (Tsuchiya, 1971, Harada, 1973). It seems likely that the member of this genus has been keeping conservative karyotype in some grade.

References


Small Mammals of Sabah, East Malaysia II

Rattus rattus. Chromosoma (Berl.). 50: 283–300.


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