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Short Communications

GEOGRAPHIC VARIATION WITHIN *Apis koschevnikovi* BUTTEL-REEPEN, 1906, IN BORNEO

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Great attention was given to the newly discovered "Red honey bee of Borneo", *Apis koschevnikovi,*during the last years mainly because of the permanent interest in complementing the knowledge of the fascinating biology, variability and evolution of honey bees (G. Koeniger *et al.*, 1994, N. Koeniger *et al.*, 1988, Mathew and Mathew, 1988, Rinderer *et al.*, 1989, Ruttner *et al.*, 1989, Tingek *et al.*, 1988). Yet almost all recent observations were from one single area, Sabah in the extreme North East of Borneo. In his monography on the genus *Apis,* Maa (1953) however, described two slightly different subspecies of this bee from Borneo, *Apis vechti vechti* (according to his terminology, see Ruttner *et al*, 1989) and *A. vechti linda.* Maa's description was solely based on a few museum specimens, and no morphometric data were available. In the present study we investigate the question whether a geographic variability can be found within the *A. koschevnikovi* populations of Borneo by morphometric methods.

Five samples of 15 bees each were collected from *koschevnikovi* colonies in Barabai, South Kalimantan Province, Borneo (Fig. 1) and analyzed morphometrically at the Apicultural Institute Oberursel using the standard method (Ruttner, 1988). The data (means of 37 body characters) were compared to those of five *koschevnikovi* samples from North Borneo (Tenom, Sabah) used in earlier study (Ruttner *et al.*, 1989). The data of the two

populations were compared by t-test, eleven characters (Table 1) which showed differences ($p<0.01$) were further investigated in a factor analysis together with characters of size (length of forewing, femur, tibia, and metatarsus of the 3rd, width of forewing). Seven additional samples of *A. cerana* from Sabah as reference group.

The data of the highly significantly different 11 characters of the North and South populations are given in Table 1. Two of these characters concern abdominal hair, one pigmentation, one body size (sternite 3, and additionally to this, size of the wax plate on this same sternite), and six of forewing venation.

Fig. 2 shows the results of factor analysis plotting factor 1 against factor 3 with the ellipses of confidence at 75%. The populations of "North" and "South" form clearly defined clusters well separated by both factors. The cluster of the distinctly smaller *A. cerana* is found far to the left.

Although the amount of investigated colonies and locations is still small and, of course, no general overview about the variation of *A. koschevnikovi* in Borneo can be given, this study shows considerable geographic variability on the island. The studied populations are well separated morphologically in a multivariate analysis at the 75% level which was used generally for establishing taxonomic units (subspecies) in honey bee (Ruttner, 1988).

Nomenclature

The honey bee species at present listed with the official name *A. koschevnikovi* has a somewhat confusing history in apidological literature. This name was first applied to one *Apis* specimen of the Berlin museum with the label "North Borneo" by Buttel-Reepen in 1906, this honey bee should be designated as lectotype of *Apis koschevnikovi* Buttel-Reepen, and the northern population should be named *A.k. koschevnikovi* Buttel-Reepen (Syn. *A. vechti linda* Maa), provided that a subdivision of the species is confirmed by future analyses (several other specimens of the same type listed by Buttel-Reepen with the origin "Cameroon" had supposedly been given a wrong label; Ruttner *et al.*, 1989).

A second variety of *A. koschevnikovi* in Borneo was described as *A. vechti vechti* by Maa (1953) from several locations in the East and in the eastern part of Central Borneo. One of the collection sites listed by Maa, Balikpapan, is not more than 170 km North East from Barabai, the collection site of our southern samples compared to about 860 km from Tenom, Sabah, the collection site of the northern type. The correct name of this southern subspecies is *A. koschevnikovi vechti* Maa 1953. Unfortunately, Maa gives no exact morphometric data of his types; therefore, the identity of the subspecies described here with those of Maa can only be concluded from the identical geographic origin.

As the southern *A. koschevnikovi vechti* was allocated by Maa along the eastern coast of the island far up to the North, it is likely that the large mountain range dividing northern Borneo into a western and an eastern part (and culminating in the Kinabalu with more than 4000 m in North East) divides also the two subspecies. Mountains may be an effective barrier for *A. koschevnikovi,* this being a lowland species, quite in contrast to the sympatric *A. cerana* (N. Koeniger pers. comm.). However, the present knowledge on the distribution of *A. koschevnikovi* is still very fragmentary, the West and South of the island being a complete "terra incognita". Although the presence of the two subspecies of *A. koschevnikovi* in Borneo as described by Maa seems to be confirmed by this study, more samples from a wider range of distribution are needed.

Notes on the Biological History of *Apis koschevnikovi*

It is of interest to state that the majority of the highly significant differences between the two subspecies is of no or questionable adaptive value as wing venation or pigmentation, and not those of body size. This could be interpreted as consequence of a slow evolutionary process (in contrast to changes in body size under the immediate selective pressure of environment by factors such as temperature).

Apis koschevnikovi is certainly not merely a local tropical offshoot of the *cerana* branch of the genus *Apis.* This is shown by the probable existence of two distinct subspecies in Borneo and, even more important, by the detection

of the same species in Sumatra (Ruttner *et al.*, 1989). N. Koeniger collected a sample from a honey bee colony in Muaro near Solok, West Sumatra Province in 1978, which proved to be beyond the range of data at this time stored in the Oberursel Data Bank. Therefore, it was first classified as "aberrant type". The redetection took place during, the measurement of the samples from Sabah, Borneo. The "Red Bee" from Sumatra is slightly smaller than *A. koschevnikovi* from Borneo (most distinct in forewing length, 8.26 mm vs. 8.54 mm), but the overall differences seem almost smaller than those between the two subspecies in Borneo. In factor analysis together with *A. cerana* and *A. mellifera,* the Sumatran sample is included in the tight cluster *of A. koschevnikovi* from Sabah; therefore, this sample certainly belongs to the same taxonomic unit. A later search for *A. koschevnikovi* in Sumatra by the first author of the present study was no success. Migration or transportation from Borneo to Sumatra are both very unlikely, therefore a common ancestral population has to be assumed on the continent as the most likely interpretation of this finding.

These observations strongly support the hypothesis regarding the present populations of *A. koschevnikovi* as relics of a larger population with a wider distribution.

Table 1. List of highly significant characters among *A. koschevnikovi koschevnikovi* and *A.k. vechti*

Character	*A.k. koschevnikovi*	*A.k. vechti*	T- value	P- value
1. Hair length (0,01 mm ± s.e)	15.97 ± 1.34	10.75 ± 0.87	7.30	0.000
2. Tomentum (0.01 mm ± s.e)	34.55 ± 1.69	27.43 ± 3.15	4.22	0.001
3. Pigment T2	5.00 ± 0.00	3.64 ± 0.38	3.78	0.002
4. Sternite 3, L (0.01 mm ± s.e)	257.57 ± 6.33	266.69 ± 2.42	3.01	0.008
5. Wax plate, L (0.01 mm ± s.e)	104.48 ± 2.92	110.80 ± 1.71	4.18	0.002
6. Cubit. a (0.01 mm ± s.e)	52.17 ± 1.13	57.05 ± 0.53	8.74	0
7. Cubit. b (0.01 mm ± s.e)	7.52 ± 0.62	9.43 ± 0.28	6.28	0
8. Angle J16	109.59 ± 2.07	100.32 ± 1.65	7.83	0
9. Angle K19	77.47 ± 0.97	74.37 ± 0.97	3.51	0.004
10. Angle N23	84.43 ± 2.20	81.45 ± 0.88	2.82	0.01
11. Angle O26	33.67 ± 1.23	30.46 ± 1.06	4.44	0.001

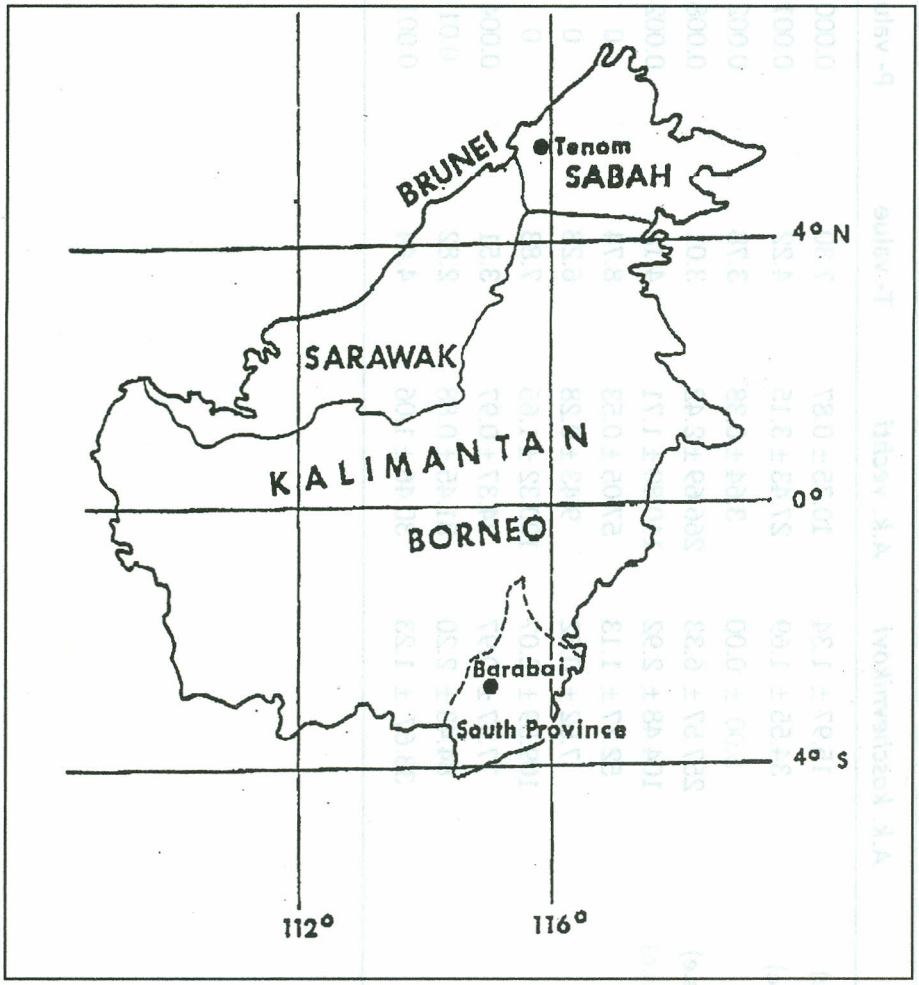

Fig. 1. Map of Borneo

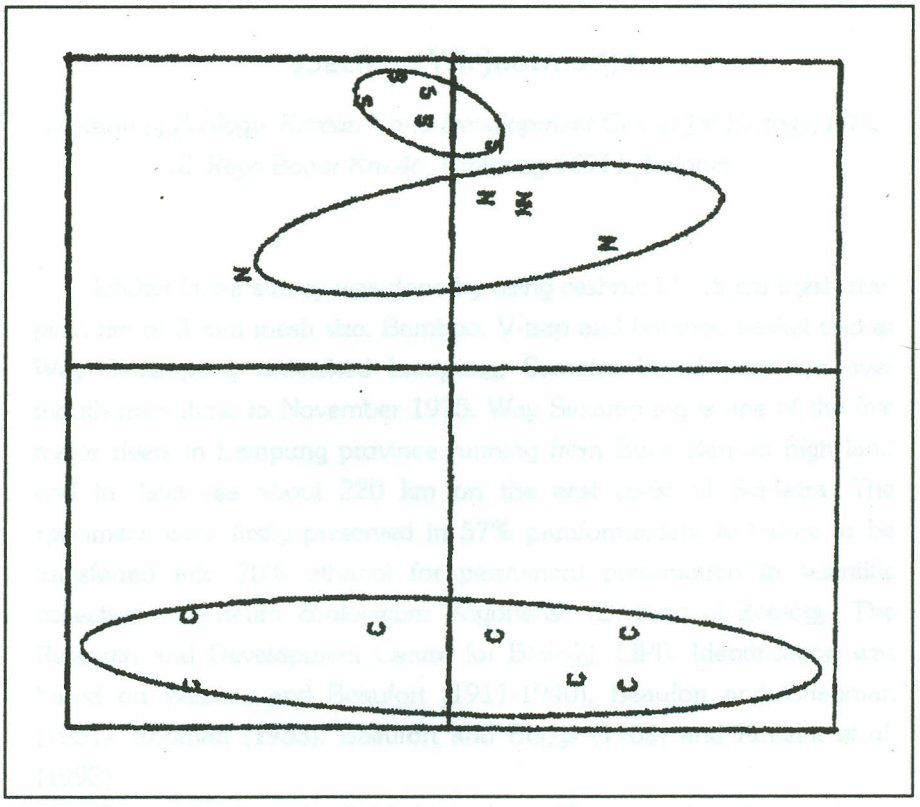

Fig. 2. Graphic presentation of the results of a factor analysis (Factor 1 and 3) with the elipses of confidence at 75% of samples of *A. koschevnikovi* from North (N) and South Borneo (S) and of *A. cerana* (C) from North Borneo