ON THE TAXONOMY OF HONEYBEES OF TROPICAL AFRICA

F. RUTTNER

FRG

For a number of years a research programme has been in progress to study the geographic variability of the species *Apis mellifera* with uniformly applied methods. The principles of these methods are the following:

1. Measurement of a great number of characters (41 in this study).

2. Collection of samples of bees from the whole autochthonous area of distribution of the species, as far as possible. One sample consists of 20 bees of one colony (except in the few cases when fewer bees were obtained only).

3. Analysis of the data by multivariate statistical analysis, mainly by the methods of principal components and discriminant analysis. The basic units in these analyses were not the values of single bees, but the mean values of samples. The results produced a number of factors for each sample, representing the condensed variations of all characters used. When these are plotted in a two or three dimensional graph, each sample is represented by one point. When samples from one place of origin give similar measurements, clouds of points are formed, called “clusters”. A well defined, geographical race should give a clearly defined cluster, separated from the others.

To obtain a global picture of the species, an analysis of all samples available at this time was attempted first, together with J. LOUVEAUX and L. TASSENCOURT (1978). It showed a large geographic variability with high values, exceeding in some cases 100% of the lowest value of one character. The races are grouped in well-defined clusters, forming altogether a well defined structure with three branches, like an “Y”. If superposed on a geographical map, with the centre on the Mediterranean, a surprising coincidence of morphometric structure with geographic distribution of the honey bee races becomes evident: The central stem of the “Y” represents the races of the African continent, one of the lateral branches those of Western Europe and the other those of the Eastern Europe and Near East (Fig. 1).

For a closer study a detailed analysis of restricted regions is necessary. Tropical Africa is of special interest, as bees from these were imported to South America and created a lot of problems.

From the study just mentioned it is obvious, that it is no problem whatever to discriminate the bees of tropical Africa as a whole from the other races; they differ from the others by their small size. The same was stated by H. DALY (1977) for the “Africanised” bees of South America. Taxonomic defining within the tropical zone is more difficult.

In the last decades it had been the general custom – for some unknown reason – to call all bees of the continental tropical Africa “adansonii”, name originally given to a bee from Senegal in the north-western corner of the continent. It is true, F.G. SMITH (1961) described two new races of bees from Tanzania, *A. m. litorea* and *A. m. monticola*, both clearly differentiated from the common *A. m. “adansonii*” of the same country. But this observation did not receive much attention, though it did not seem very likely that all bees of the large zone of tropical Africa should be the same taking into consideration the plasticity of the species.

The differentiation between honey bee races on the African continent was attempted in a paper presented at the 25th APIMONDIA Congress Grenoble (RUTTNER, 1975). 11 geographic races were examined; the problem “*adansonii*” however was solved only tentatively. The cluster of the East African “*adansonii*” seemed to be separated from the few samples available from West Africa. Thus the designation “*scutellata*” (given to a bee from South Africa in 1836 by LEPELLETIER) was proposed, while the use of the name “*adansonii*” should be restricted to the bees of West Africa. For a final decision however the bees of this region had to be better represented.

Since then a great number of new samples have been at our disposal from East and Central Africa (Kenya, Chad, Moçambique) and especially from West Africa (Senegal, Guinea, Ivory Coast, Togo, Nigeria, Cameroun, Congo, Gabon). The data of 133 samples (comprising a total of 2,534 bees) show clearly that a definite statistical separation results between the bees from east and those from the west, as well as between the samples of Central and North Africa.

Based on the data available at present, five distinct morpho-geographical groups can be established:

1. *A. m. scutellata Lepeletier*, the bees of the savanna of the East African highland: Samples from Ethiopia, Kenya, Tanzania, Rwanda, Burundi, Zimbabwe, South Africa.

2. *A. m. litorea* Smith, of the coastal region of East Africa, from Lamu, Mombasa, Tanga to Moçambique.

3. *A. m. monticola* Smith found in the mountain region of East Africa at altitudes higher than 2200 m. Documented from Ethiopia, Kenya and Tanzania.

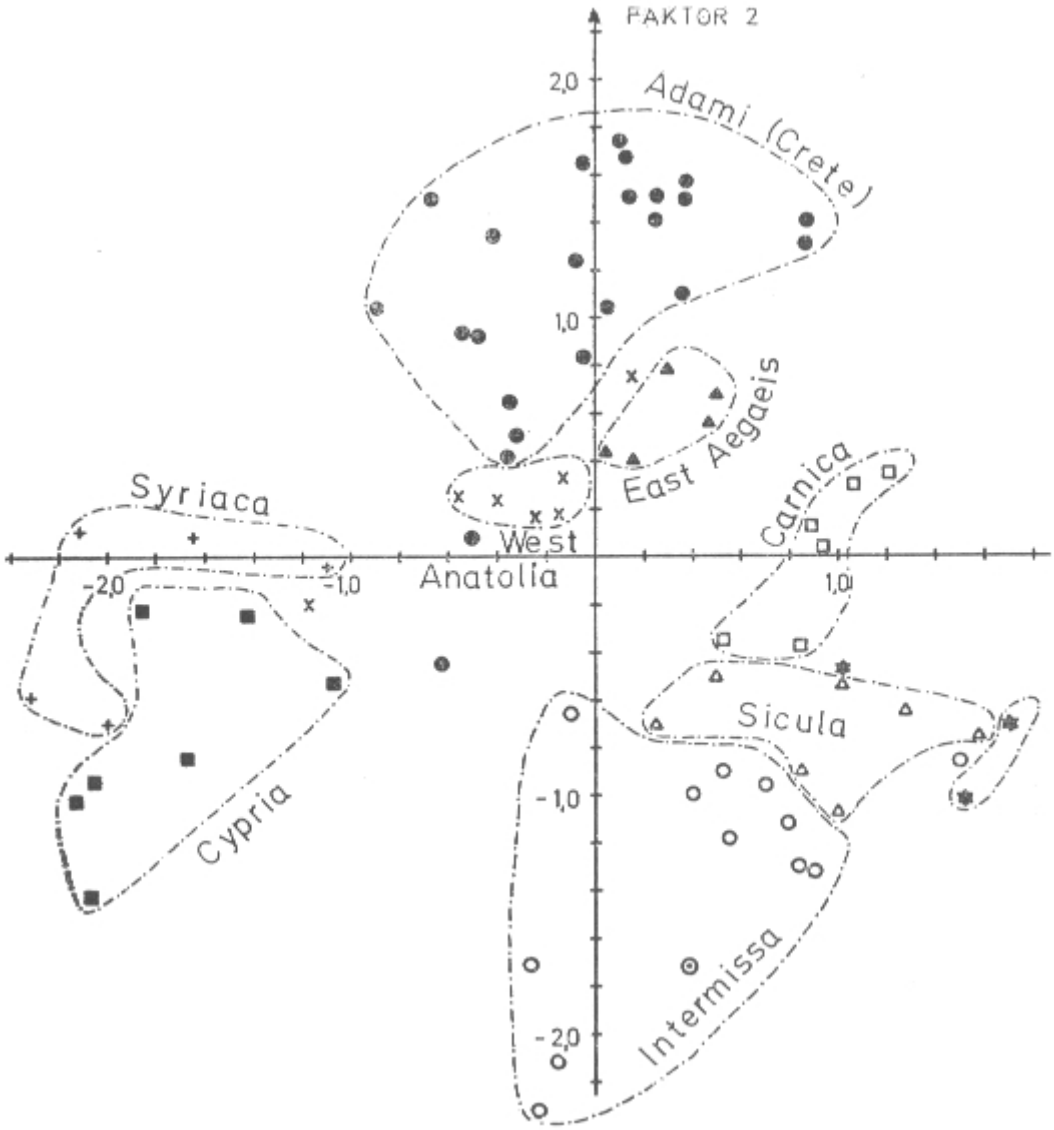

Fig. 1 – On the abscissa, factor 1; on the ordinate, factor 2

4. *A. m. adansonii* Latreille in Westafrica from Senegal to Congo. No samples from Zaire and Angola have been examined yet.

5. *A. m. yemenitica* RUTTNER, in dry areas of Central and East Africa and South Arabia (Chad, Sudan, Yemen, Oman).

The differences between these types are substantial and concern many characters of size, hairs, colour, wing venation and body proportions. In Table 1 the races of tropical Africa are ranged according to their size and are compared with the bee of North West Africa, *A. m. intermissa*. It is clearly shown that all races of Africa south of the Sahara are smaller than the Tell bee, and are more yellow.

A. m. scutellata takes a medium position in respect of all characters of size and of colour. *Monticola* is larger and darker, *adansonii* by about the same extent smaller, and is also more yellow (Table 1).

A. m. yemenitica is the smallest and the most yellow of all races known so far. A minimum length of the proboscis of 5.21 mm in one sample, compared to one sample of *A. m. major* with 7.12 mm shows the whole amplitude of the geographic variation in *Apis mellifera*.

Table 1

Measured values of 7 characters of *A. m. scutellata* compared with the values obtained from other four races (given as differences to *scutellata* and to *A. m. intermissa)*

Character	*yemenitica*	*litorea*	*adansonii*	*scutellata*	*monticola*	*intermissa*
Proboscis (mm)	-0.47	-0.07	-0.17	5.86	+0.20	+0.52
Hind leg (mm)	-0.48	-0.30	-0.10	7.58	+0.10	+0.54
Length of forewing (mm)	-0.56	-0.26	-0.21	8.66	+0.19	+0.52
Length of tergite 3+4 (mm)	-0.28	-0.25	-0.16	4.17	±0.0	+0.26
Colour of tergite 4 (scale from 0.0 = completely dark to 9.0 = completely yellow)	+1.06	+0.21	+0.35	4.00	-1.01	-2.90
Cubital index	-0.26	-0.27	-0.13	2.52	-0.18	-0.30
Angle of wing venation 16	+0.21	-1.09	+2.55	92.40	-6.00	+3.36

It came as a surprise when it turned out that *A. m. yemenitica* is more than a special local race as had been assumed when it was first described in 1975 from North Yemen. Later the same very typical bee was observed in Oman (DUTTON, RUTTNER, 1981), when it was further shown, that the samples from Sudan and from Chad could not be separated statistically from *yemenitica*. The same small bee was found also in the dry north east of Kenya (J. MBAYA, pers. comm.). Thus this type seems to have a large distribution in the very dry areas of northeastern Africa and of South Arabia.

The same extension in mapping the area of distribution occurred also in *A. m. litorea*. First described for a small area on the coast of Tanzania only, it is now identified from the coastal region of Kenya to the north, and of Moçambique to the south.

These findings are the reason why no map of distribution of the races described has been included in this paper. This would only give the impression of a completeness which does not exist. What we provide here is no more than a number of fixed points, uneavenly distributed over the continent, which give an idea of the taxonomic structure of the species in this area, but no boundaries.

Tropical Africa, as zoogeographical region, is essentially different from e.g. the Mediterranean in one important point: There are no topographical barriers, such as high continuous mountain ranges or expanses of water. Thus the populations of honeybees were never completely isolated one from the other, an exchange of genes occurred always (favoured by a marked swarming impulse), and this is also expressed by the result of the statistical analysis: There are no sharply separated clusters as those shown in Fig. 1, but the clusters are interlinked and connected with each other by transitory types (Fig. 3). This was to be expected in a situation such as in Tanzania where three different races occur in a relatively restricted area, separated only by different altitudes (SMITH, 1961).

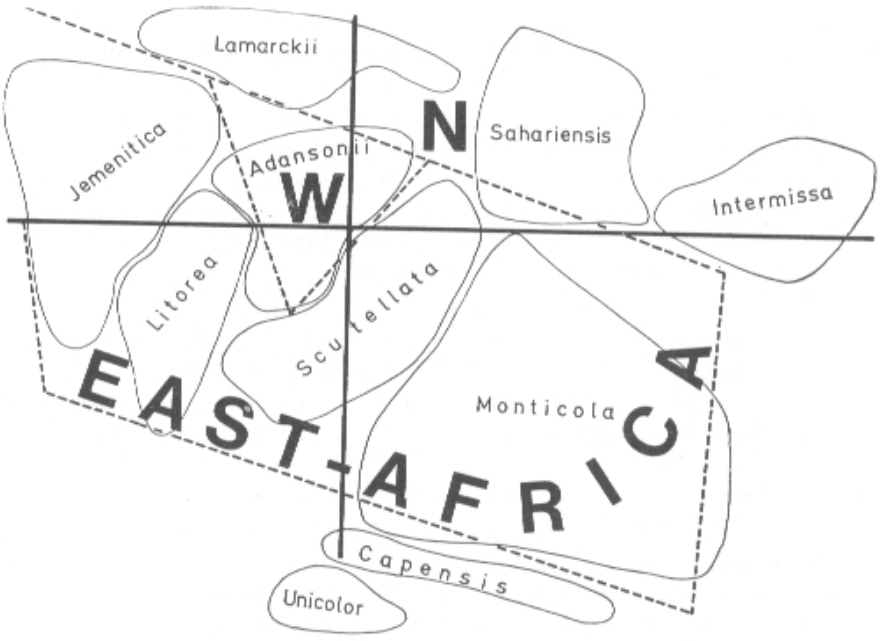

Fig. 2 – Statistical defining of bee races of north Africa (N), of west Africa (W), and of east Africa

Fig. 3 – Distribution of samples from tropical Africa, as resulted from multivariance analysis:
A – adansonii*; J* – yemenitica*; L* – litorea*; M* = monticola*; S* – scutellata*. The other capital letters – centers of races*

There exists however another powerful trend in the evolutionary differentiation within the species: The adaptation to the environment. The tropical races described are not restricted to a certain country or to a geographically defined area, but to a specific zone of climate and vegetation. Ecological differences are responsible for the origin and maintainance of morphometric differences in bees.

Thus it is not surprising that *litorea* from the east coast shows greater similarity to *adansonii* from the west coast, than to *scutellata* from the uplands – in spite of the longer geographic distance. The statistical distance (the cummulative sum of the normalized differences of characters) *litorea-adansonii* is 346.9, while the distance *litorea-scutellata* is 522.1. These taxonomic units within the species *Apis mellifera* may be therefore called “eco-geographic races”.

It is beyond doubt that tropical Africa has an enormous potential for beekeeping. Some countries of the continent, such as Angola, have always been the most important producers of beeswax. Much can be done to develop beekeeping there. To provide a better knowledge of the native bees of this zone would be a basic step for this purpose. It is also not without interest to know that the bee introduced to South America from Africa was not *Apis mellifera adansonii*, but *A. m. scutellata*.