

## Morphometrical investigation in Syrian honeybees

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**Summary** — Twenty-seven samples from 8 locations covering the main regions of Syria were analysed morphometrically according to the methods of Ruttner *et al* (1978). Bees were identified by discriminant analysis as *Apis mellifera meda* in the north and north-east of Syria and as *A m syriaca* in the south. Between these regions, both races were found. *A m meda* samples were close to the eastern sub-population of *A m meda* (Iraq), and differed distinctly from the north-western subpopulation (Turkey). In the Damascus area, 3 samples were clearly identified as *A m ligustica* probably originating from importation of these bees. The results show an original north-south transition of predominance from *A m meda* to *A m syriaca* approximately between Damascus and Hama, which is increasingly obscured by increased mobility in modern beekeeping. While some characteristics indicate hybridization, others point to local variation of the races specific to Syria.

*Apis mellifera* / biogeography / morphometry / Syria

### INTRODUCTION

Beekeeping in Syria is in a state of change. Of the approximately 580 000 bee colonies in Syria only about 40% are still kept in traditional cylindrical wood hives covered by mud; most beekeepers have changed to 1-box Langstroth hives. This change was accelerated by the necessity to treat against varroaosis.

Toward the north and north-east of Syria, south-east Anatolia and Iraq are inhabited by the race *A mellifera meda*, while toward the south Israel, Jordan and Lebanon are in the

area of distribution of *A m syriaca* (Ruttner *et al*, 1985). As no samples of Syria have been analysed up to now, the distribution of these races within Syria and the transition between them is still not clear.

### MATERIALS AND METHODS

Samples of bees with 15 workers each were taken from 27 colonies at 8 locations: the coastal area (Latakia 3), north Syria (Hama 4); north-east Syria (Qamishli 2); Khabur and Euphrat valley (Haseke 2 and Deir ez Zor 2); middle Syria (Damascus 9) and south Syria (Quneitra 4, Dera 1). The locations are given in figure 1.

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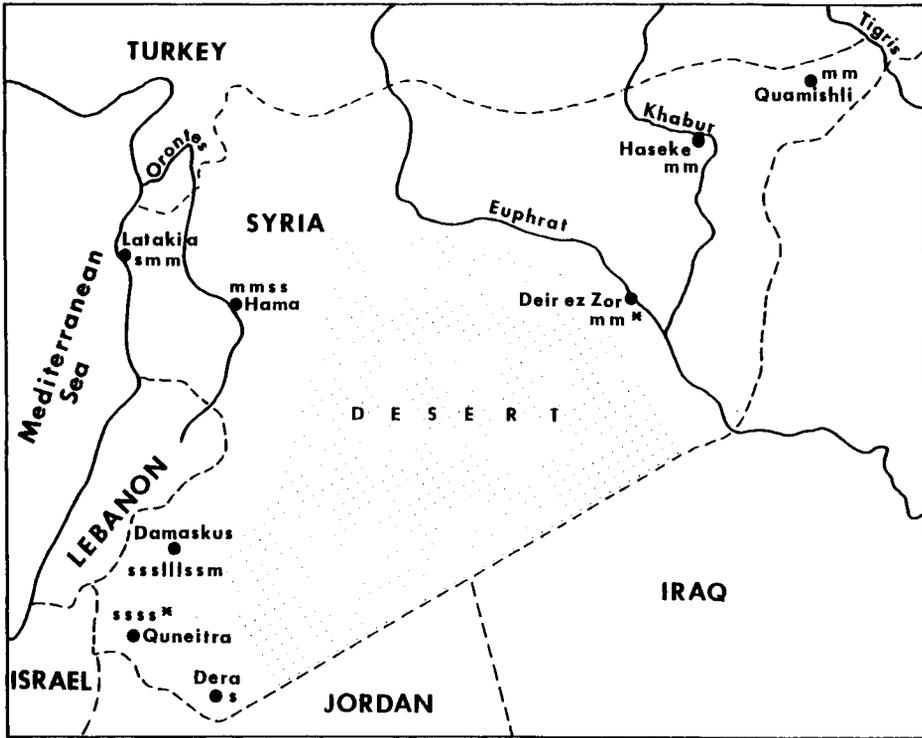


Fig 1. Map of Syria with locations where bee samples have been collected. Samples are marked according to their classification as *A m meda* (m), *A m syriaca* (s) or *A m ligustica* (l). Classification with  $P < 95\%$  are marked by \*. No bees are kept within the central desert (stippled area).

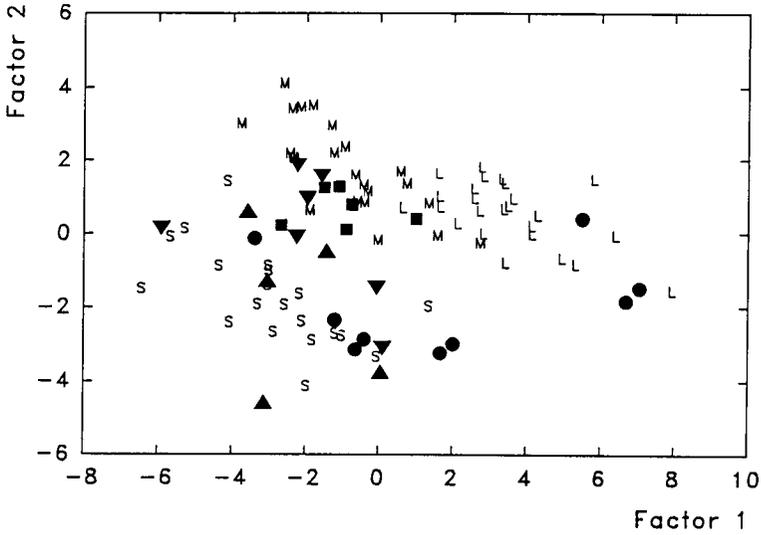
Samples were preserved in 70% ethanol and bees were dissected according to the methods given by Ruttner *et al* (1978). Thirty-nine morphometric characteristics were measured. Characters of size as well as venation angles were measured using a CCD camera and PC-on-screen digitizing system. Hairlength, length and width of tergites, tomenta and pigmentation were measured by microscopy and with an ocular micrometer.

Data were analysed by factor analysis and discriminant analysis (SPSS/PC, 1988). As a reference, data of 69 classified samples from the morphometric data bank Oberursel were used (*A m meda*: 9 samples from Anatolia and 15 from Iraq; *A m syriaca*: 20 samples from Lebanon, Israel and Jordan; *A m ligustica*: 25 samples from Italy). All characters except length of proboscis and pigmentation of terga 2 and 4 were included in the analysis.

## RESULTS

In factor analysis 3 main factors (principal components) were identified. These explained 30, 11 and 10% of the variance, respectively. Figure 2 shows a plot of the first 2 factors. Factor 1 is predominantly correlated positively with size, while factor 2 is correlated positively with hairlength and width of metatarsi and negatively with the length of the legs and distance of wax mirrors.

As can be seen, most samples (24) fall into the same range as *A m meda* and *A m syriaca* in regard to factor 1. Three samples from Damascus, however, are clearly separate and fall into the range of *A m ligus-*



**Fig 2.** Factor analysis of morphometrical characteristics of worker bee samples from Syria showing the 2 most significant principal components. ▼ = north and west Syria; ■ = east Syria; ● = Damascus, ▲ = south Syria. Samples from data bank Oberursel: L = *A m ligustica*, M = *A m meda*, S = *A m syriaca*.

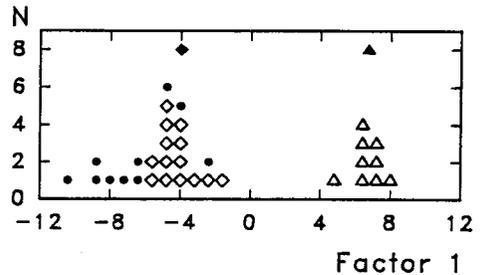
*tica*. For factor 2, the samples are distributed between the range of *A m meda* (7) and *A m syriaca* (8), with a number in intermediary positions. Samples from north and north-east Syria are predominantly within or near the *A m meda* cluster, while samples from middle and south Syria are predominantly closer to the *A m syriaca* cluster.

Samples were assigned to the races *A m meda*, *A m syriaca* and *A m ligustica* by discriminant analysis. All except 2 of the samples were grouped at a probability level of more than 95%. Three samples from Damascus were clearly identified as *A m ligustica*. Of the remaining 22 samples, 10 were classified as *A m meda* and 12 as *A m syriaca*. The local distribution of the classified samples is given in figure 1. In the eastern parts, all the samples were *A m meda*. In the western parts, all southern samples were *A m syriaca*, while north of Damascus increasing proportions were classified as *A m meda*. Uncertain classifications in Quneitra, and Deir-ez-Zor were intermediate

between *A m syriaca* and *A m meda*, mainly confirming the general pattern.

*A m meda* samples used as reference group came from Anatolia and Iraq, representing 2 distinguishable subpopulations (fig 3). All *A m meda* samples from Syria were grouped with high probability ( $P > 99.99\%$ ) with the samples from Iraq.

Means of some of the morphometric measurements are given in table I for the



**Fig 3.** Discriminant analysis of Syrian *A m meda* samples (●). Reference groups: *A m meda* from Anatolia (Δ) and from Iraq (◊), data bank Oberursel. ▲, ◆ give the respective group centroids.

**Table I.** Characteristics of *A m syriaca* and *A m meda* from Syria and from adjacent countries (data bank Oberursel).

Characteristics	<i>A m syriaca</i>		<i>A m meda</i>	
	Syria N = 13, *11	Data bank N = 20, *19	Syria N = 9, *8	Data bank N = 25, *13
Body size T3+4 (L)	4.33 ± 0.09	4.20 ± 0.17	4.39 ± 0.1	4.30 ± 0.10
Hair (L)	0.221 ± 0.03	0.23 ± 0.03	0.25 ± 0.03	0.27 ± 0.02
Hind-leg (L)	7.80 ± 0.23	7.90 ± 0.14	7.82 ± 0.25	7.72 ± 0.17
Fore-wing (L)	8.45 ± 0.25	8.56 ± 0.17	8.50 ± 0.21	8.81 ± 0.17
Fore-wing (W)	2.86 ± 0.09	2.85 ± 0.07	2.96 ± 0.07	3.03 ± 0.06
Proboscis (L)	6.21 ± 0.20*	6.26 ± 0.15*	6.31 ± 0.13*	6.23 ± 0.21*
Pigment (T3)	7.26 ± 0.73	7.63 ± 0.43	8.32 ± 0.51	8.32 ± 0.50
Slenderness (I)	80.03 ± 1.19	83.90 ± 2.10	80.34 ± 1.62	81.62 ± 1.40
Cubital (I)	2.30 ± 0.26	2.28 ± 0.27	2.45 ± 0.26	2.57 ± 0.24
Wax mirror (D)	0.36 ± 0.03	0.32 ± 0.04	0.29 ± 0.04	0.27 ± 0.03
G 18 (ang)	95.53 ± 1.42	97.07 ± 1.97	92.94 ± 2.11	96.03 ± 2.17
N 23 (ang)	87.71 ± 2.36	89.74 ± 1.42	86.65 ± 2.19	89.21 ± 5.02
O 26 (ang)	36.23 ± 2.60	37.66 ± 2.47	33.66 ± 1.64	33.21 ± 2.00

Values are means and standard deviation of colony sample means, *N* = number of sampled colonies, with asterisks for proboscis. T = tergite; L = length (mm); W = width (mm); D = distance (mm); I = index; G18, N 23, O 26 wing venation angles, ang = angle (degrees); slenderness = length/width of sternite 6; pigmentation 0 = completely dark, 9 completely bright. Measurements taken according to Ruttner *et al* (1978).

samples classified as *A m syriaca* and *A m meda*, and for the reference groups.

## DISCUSSION

Most beekeeping in Syria takes place in the western mountainous areas (Jebel Ansarya, eastern slopes of Antilebanon). This area stretches from north to south parallel to the Mediterranean Sea and is limited to the east by the central deserts. A second area in the north stretches from the west to the east along the mountainous areas towards Turkey and Iraq, and along the river valleys of Euphrat and Khabur. No beekeeping is possible within the central deserts (fig 1).

Syria forms a bridge between countries in the north and north-east (Turkey, Iraq) inhabited by *A m meda* and those in the

south (Jordan, Lebanon, Israel) inhabited by *A m syriaca*. *A m meda* is the honeybee of the Central Iranian Highlands, with several subpopulations in the north, north-east, south and west, while *A m syriaca* is considered as the honeybee of the mountain range bordering the eastern Mediterranean Sea. Both races belong to the eastern group of the subspecies of *A mellifera* (O branch; Ruttner, 1988).

The classification of samples shows a clear predominance of *A m meda* in the north and north-east of Syria. In contrast, *A m syriaca* is predominant in middle and south Syria. This predominance ends north of Damascus, but a proportion of *A m syriaca* samples were still found at Hama and Latakia. Unfortunately, no samples were available further north towards Anatolia, where the occurrence of *A m syriaca* becomes increasingly unlikely.

Surprisingly an extension of the area of *A m meda* from the climatically very continental highlands of south-east Anatolia to the coast of the Mediterranean had been established, without recognizable geographical barriers to the area of *A m anatoliaca* in the west (Ruttner, 1988). A similar pattern was found in this study. The extension to the Mediterranean coast of an *A m meda* population continued into Syria without a barrier to the area of *A m syriaca*, but with a zone of hybridization.

The *A m meda* samples of Syria were clearly distinct from the local *A m meda* variation from Turkey, but very close to the reference group from Iraq. Samples from Turkey were all from the eastern mountainous areas (except 1 from the equally mountainous Mediterranean coast at Mersin). Samples from Iraq were from the northwestern parts, bordering Syria. This is likely to reflect a north-south biogeographical variation of *A m meda* from the high Anatolian mountains to the lower areas of northern Syria and Iraq.

Contact between *A m meda* and *A m syriaca* is limited to a comparatively narrow zone of hybridization in the northern parts of Syria. Farther to the south and east, both races are efficiently separated by the Syrian desert (fig 1). This also precludes direct contact to the bees of central Iraq, which were seen by Abdellatif *et al* (1977) as a subdivision of *A m syriaca*, leaving the position of these bees unclear (Ruttner *et al*, 1985).

The general pattern is, however, confused by exceptions. Three samples from Damascus (from 1 breeder) were clearly identified as *A m ligustica*. It is known that this race is occasionally imported into the region but seems not to establish over longer periods. In the area predominated by *A m syriaca*, 1 sample was classified as *A m meda* (at Damascus), and 1 was uncertain between *A m meda* and *A m syriaca* (at Quneitra). At the same time 1 sample within the *A m meda* area tended towards *A m syriaca* (at Deir-ez-Zor). The finding of

different races at the same places (at Hama) shows the increasing tendency of beekeepers to obscure the original geographical distribution of the races by transport of colonies and importation of foreign races.

Although the samples mainly correspond to the *A m syriaca* and *A m meda* type, some characteristics are intermediate (hair-length, cubital index), indicating effects of hybridization. However, workers of both races are bigger and less slender than their respective reference groups from the data bank, and have shorter wings. In addition, the Syrian type of *A m syriaca* has a shorter proboscis than all 3 other groups. It thus seems that the bees of Syria are not entirely mere extensions of the *A m meda* and *A m syriaca* races and their hybrids, but also show characteristics of their own.

## ACKNOWLEDGMENTS

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**Résumé — Étude biométrique des abeilles (*Apis mellifera* L) de Syrie.** Vingt-sept échantillons ont été prélevés dans 8 localités de Syrie selon la méthode de Ruttner *et al* (1978) et 39 caractères morphométriques ont été mesurés. Les relations avec les races des pays voisins ont été déterminées par analyse factorielle et analyse discriminante des données en comparaison avec des échantillons de la banque de données d'Oberursel. Dans les régions nord et nord-est de la Syrie les abeilles ont été identifiées comme étant *Apis mellifera meda*, et au sud de la chaîne côtière méditerranéenne comme *A m syriaca*. Dans la zone de transition de la région désertique on trouve les 2 races ; il s'agit vraisemblablement d'une zone d'hybridation. *A m meda*

de la région orientale est séparée d'*A m syriaca* de la région méridionale par le désert de Syrie (fig 1). Quelques exceptions à ce schéma général de répartition sont significatives de la tendance croissante des apiculteurs à transporter leurs ruches et importer des races étrangères. Trois échantillons de Damas ont été déterminés comme *A m ligustica*. Les échantillons syriens d'*A m meda* ressemblent plus à la variété locale d'*A m meda* des régions voisines du nord-ouest de l'Irak qu'à la variété indigène des régions septentrionales de la Turquie de l'est. Cela indique l'existence d'une variation biogéographique nord-sud au sein d'*A m meda* depuis les montagnes de la Turquie orientale jusqu'aux régions basses du nord de la Syrie et de l'Irak. Pour certains caractères les abeilles des échantillons analysés présentent des signes d'hybridation entre les 2 races. Elles sont plus grosses et plus larges que les groupes de référence, avec une tendance au raccourcissement de l'aile. Il semble donc que les abeilles de Syrie ne soient pas uniquement une extension des races *A m meda* et *A m syriaca* et de leurs hybrides, mais qu'elles possèdent des caractères propres.

#### ***A m meda* / *A m syriaca* / morphométrie / biogéographie / Syrie**

**Zusammenfassung — Untersuchung morphometrischer Eigenschaften von syrischen Honigbienen.** Für eine morphometrische Untersuchung syrischer Bienen wurden 27 Bienenproben aus 8 Orten Syriens nach der Methodik von Ruttner *et al* (1978) ausgewertet. Die Beziehungen zu den Bienenrassen umliegender Länder wurden anhand von Vergleichsproben aus der Oberurseler Datenbank durch Faktoren- und Diskriminanzanalysen bestimmt. In den nördlichen und nordöstlichen Teilen Syriens wurden die Bienen als *A m meda*, im Süden der mediterranen Küstengebirge als *A m syriaca* bestimmt. Im Übergangsbe-

reich der Küstenregion wurden beide Rassen gefunden hier ist eine Hybridisierungszone wahrscheinlich. *A m meda* der östlichen Bereiche ist von den südlichen Vorkommen von *A m syriaca* durch die syrische Wüste abgetrennt (Abb 1). Einige Ausnahmen zu diesem generellen Verbreitungsmuster zeigen den Einfluss erhöhter Mobilität in der Bienenhaltung. Drei Proben aus Damaskus wurden als *A m ligustica* bestimmt. Die syrischen Proben von *A m meda* ähneln eher der Lokalvarietät von *A m meda* in den benachbarten nord-westlichen Teilen des Irak als der in den nördlichen Gebirgen der östlichen Türkei heimischen Varietät. Dies deutet auf geographisch bedingte Merkmalsunterschiede innerhalb von *A m meda* im Übergang vom Hochland der östlichen Türkei zu den flacheren Bereichen des nördlichen Syrien und Irak hin. In einigen Merkmalen zeigten die Bienen in den untersuchten Proben beider Rassen Hybridisierungseffekte. Darüberhinaus waren sie grösser und in der Proportion breiter als die Vergleichsgruppen, mit einer Tendenz zu kürzeren Flügeln. Über die Zuordnung zu den Rassen der angrenzenden Länder hinaus zeigen die Bienen Syriens damit eigene Charakteristika.

#### ***A meda* / *A syriaca* / Morphometrie / Biogéographie / Syrien**

#### REFERENCES

- Abdellatif MA, Abou-Elnaga AM, Ali MH, Shakir PM, Al-Jalili MK (1977) Biometrical studies on Iraqi honeybees. *J Apic Res* 16, 143-144
- Ruttner F (1988) *Biogeography and Taxonomy of Honeybees*. Springer-Verlag, Berlin
- Ruttner F, Tassencourt L, Louveaux J (1978) Biometrical-statistical analysis of the geographic variability of *A mellifera* L. *Apidologie* 9, 363-381
- Ruttner F, Pourasghar D, Kauhausen D (1985) Die Honigbienen des Iran. 2. *Apis mellifera meda* Skorikow, die Persische Biene. *Apidologie* 16, 241-264
- SPSS/PC + Advanced Statistics V2 0 (1988) SPSS Inc 444 North Michigan Avenue, Chicago, IL 60611, USA