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DETERMINATION OF THE CUBITAL INDEX AT HONEY BEES FROM AUTOCHTHONOUS POPULATION (*APIS MELLIFERA MACEDONICA*) IN MARIOVO REGION

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Abstract

Cubital index is an important characteristic of the wing veins used for analysis and determination of honey bees' subspecies. In these studies the cubital index has been analyzed, which served as a parameter for determination of honey bees' breed.

For analysis of the cubital index in honey bees were explored three sites in Mariovo region (Makovo, Rapes and Gradesnica). From each site randomly were selected two bee families and there have been collected 30 front right wings from worker bees. Samples were taken from the front right wing, than fixed, scanned and analyzed with the Cybis CBeeWing - Bee Wing Analyzer Program (Version: 1.1.8 2003-03-08). With this method wings were morphometrically examined.

Results showed that the average values of cubital index have broad distribution and belong to various classes. We discovered that the values of the cubital index are divided in seven, eight and nine classes. The lowest average value of the cubital index is found in Rapesh and the highest value is found in Gradeshnica.

We can conclude that established cubital index average indicates the possible presence of different subspecies in the Mariovo region. The average values of cubital index are lower to those already published for *Apis mellifera macedonica*.

***Key words**: Cubital index, Morphometric analysis, Honey bees, Breeding.*

1. Introduction

In the Republic of Macedonia widespread is Macedonian subspecies of honey bees *Apis mellifera macedonica*. This subspecies is firstly described by Ruttner [5], based on morphometric research of bees examples of bees workers from Balkan Peninsula. He concluded that this population of honey bees is different from the neighbouring *Appis meliffera carnica* and *Appis mellifera cecropia*.

Cubital index represents characteristics of group of wings nerves by which is possible to analyse or determine subspecies affiliation of honey bees. Analysing the cubital index and some other characteristics of the wings nerves, many scientists (Orantez-Bermejo [3], Ruttner [4 and 5], and others) established significant differences between sites in the subspecies of the honey bees.

Based on morphometric research, few strains of *Appis mellifera carnica* at the territory of the Republic of Macedonia in regions of: Pozarane, Gevgelija, Dojran, and Mariovo were established (described by Sljahov [9]). In the last two decades, in Republic of Macedonia are conducted many investigations about honey bees wing nerves morphometric and it is established significant diversity in population (Kiprijanovska *et al.*, [1], Naumovski *et al.*, [2], Uzunov, [6], Uzunov *et al.*, [7]). According Uzunov [7], bees from researched apiaries are characterized with expressed interpersonal variability and diversity. With elevated altitude variability decreased and vice versa. Recent investigation showed that cubital index of honey bees from subspecies *Apis mellifera macedonica* is from 2.18 - 2.59 and for *Apis mellifera carnica* is 2.51 to 2.94 (Ruttner, [4]). According Discriminant Analysis with Numerical Output (DAWINO) standard [10], average value of cubital index at *Apis mellifera macedonica* is 2.6 and at *Apis mellifera carnica* is 2.8. In 2009 Uzunov *et al.*, [7], in 1800 examples taken from the whole territory of Republic

of Macedonia (without examples from Mariovo region) discovered that the average value is 2.45. In studies that were done by Sljahov [9], discovered that the average value of cubital index at honey bees at Mariovo region is 3.23 and 3.36.

2. Materials and Methods

For analyzing the cubital index at honey bees in Mariovo region, samples were taken from three different sites: Makovo, Rapesh, and Gradeshnica. From each site randomly were chosen two bee families and from the same families thirty bee workers were collected and were kept in 96% alcohol.

From examples front right wings were cut out, fixated on specially prepared cardboards, scanned and analyzed with program Wing Analyzer Program (Version:1.1.8 2003-03-08). For determination the differences between bee families cubital index as a characteristic of wing nerves is analysed. Detailed analysis of cubital index is made with average values of the characteristic, analysis of the distribution and dispersion of the values per class with a size of 0.2.

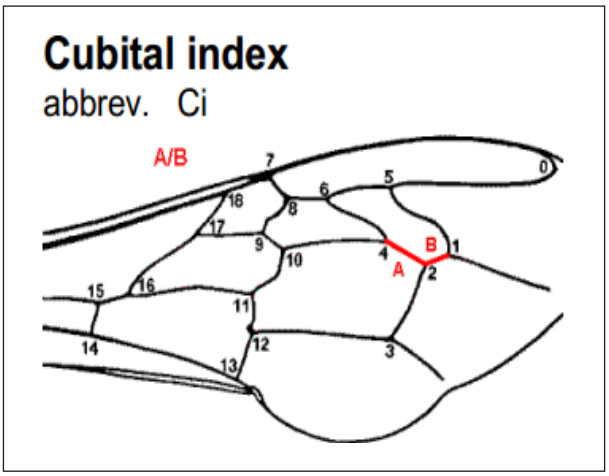

Figure 1. Cubital index of working bee's wing (DAWINO standard)

3. Results and Discussion

The data for the values of the cubital index from three apiaries, as well as the average value, standard deviation and the coefficient of variation by bee family are given in Table 1 while their of classes schedule is given in Table 2.

Table 1. Values of the cubital index of worker bees and the average value, standard deviation and the coefficient of variation by bee family

	Apiary							Apiary					
	Makovo		**Rapesh**		**Gradeshnica**			**Makovo**		**Rapesh**		**Gradeshnica**	
	Bee family		Bee family		Bee family			Bee family		Bee family		Bee family	
No. of bee	**1**	**2**	**1**	**2**	**1**	**2**	**No. of bee**	**1**	**2**	**1**	**2**	**1**	**2**
1	1.9	2	2.3	1.3	2	1.4	**16**	1.6	1.7	2.1	2	1.9	2.1
2	2.2	1.8	1.9	1.5	1.9	2,4	**17**	2	2.5	1.7	2.7	1.6	2.2
3	2.1	1.6	2.8	1.7	2.7	2.4	**18**	1.8	2.3	1.7	2.8	2.4	2.2
4	2.4	1.9	1.6	1.5	2	2.4	**19**	2.3	1.8	2.3	1.8	1.8	1.8
5	2.4	2	2.1	2.8	2.2	2.5	**20**	1.8	2.3	2.6	1.7	1.8	2.5
6	2.4	2.1	1.6	2.4	2.1	2.3	**21**	1.6	2.3	3	1.5	2.7	2
7	1.9	2.1	1.8	2.4	2.2	1.9	**22**	1.8	1.5	1.8	1.7	1.9	2.2
8	1.8	2.2	2.1	2.5	1.5	3.5	**23**	1.7	3	1.9	1.8	2.3	1.8
9	2.8	2.1	2.6	1.5	2.1	2.1	**24**	2.4	2.1	2.2	2.8	2.1	1.9
10	2.3	2	2	1.6	2.2	1.7	**25**	3.4	2.4	1.9	1.6	2.2	2.7
11	2	2	2.2	1.9	2.5	2	**26**	2	2.5	1.8	1.8	2.6	2.5
12	2.4	1.9	1.9	1.3	1.9	3.1	**27**	2.2	2	1.5	2.2	2.6	2.2
13	2,8	1,9	2	1,6	1,7	2,4	**28**		3,3	1,9	2,2		
14	2,3	1,7	1,9	2	2,3	2,1	**29**		1,9	2,3	1,8		
15	2,2	2,5	3	2,8	2,4	2,4							
							$\bar{x}$	2,17	2,12	2,09	1,97	2,13	2,25
							SD	0,41	0,33	0,41	0,50	0,33	0,42
							CV	0,19	0,15	0,20	0,25	0,15	0,19

Table 2. Schedule of values of cubital index from three apiaries in classes

	Apiary					
	Makovo		**Rapesh**		**Gradeshnica**	
	No of bees		No of bees		No of bees	
Classes	**Bee family 1**	**Bee family 2**	**Bee family 1**	**Bee family 2**	**Bee family 1**	**Bee family 2**
1.21 - 1.40	0	0	0	3	0	1
1.41 - 1.60	2	2	3	6	2	0
1.61 - 1.80	4	4	5	7	3	3
1.81 - 2.00	5	9	8	3	7	4
2.01 - 2.20	4	5	5	2	6	7
2.21 - 2.40	9	4	3	2	4	6
2.41 - 2.60	0	3	2	1	3	3
2.61 - 2.80	2	0	1	5	2	1
2.81 - 3.00	1	1	2	0	0	0
3.01 - 3.20	0	0	0	0	0	1
3.21 - 3.40	1	1	0	0	0	0
3.41 - 3.60	0	0	0	0	0	1

Cubital index in form of variation curves are presented on Figures 1, 2, 3, 4, 5 and 6. Subspecies affiliation and variability in bee families are calculated by average values of cubital index and variation curve.

On Figure 1 are presented values of cubital index from bee family 1 arranged in 8 classes with the broad distribution of the values and appearance of one peak. The average value of bee family 1 equals 2.17 and is most similar to the values given by Ruttner [5] for *Apis mellifera macedonica*, which is from 2.18 to 2.59.

From the Figure 2 where values are presented for bee family 2, we can conclude that the values of cubital index are arranged in 8 classes and there are on peak like in the first family. Based on the average value of bee family 2 which is 2.12 we can conclude that this family also belongs to the population of *Apis mellifera macedonica*.

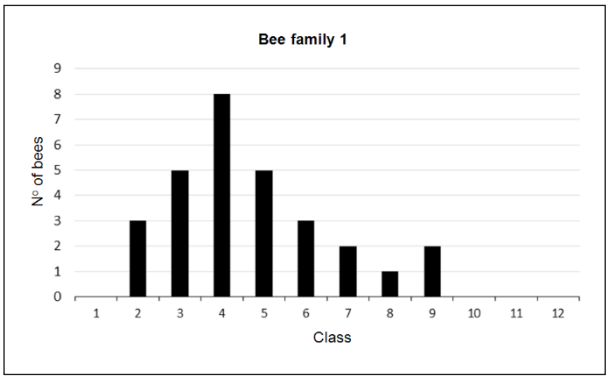

Figure 1. Variation curve of cubital index from bee family number one from apiary in Makovo

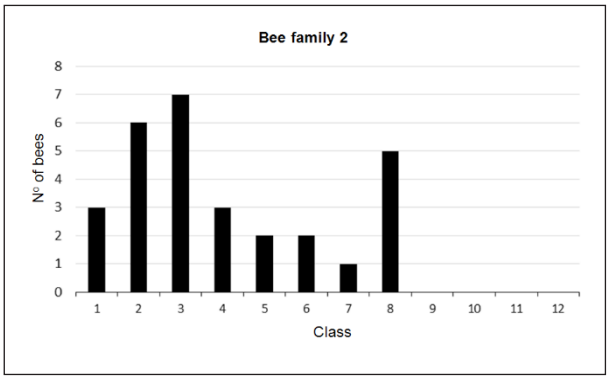

Figure 2. Variation curve of cubital index from bee family number two from apiary in Makovo

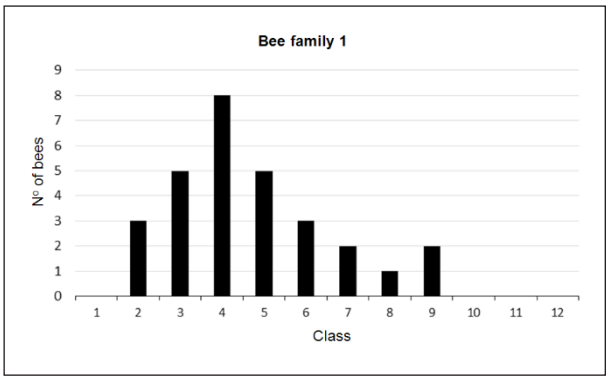

Figure 3. Variation curve of cubital index of bee family 1 from apiary of Rapesh

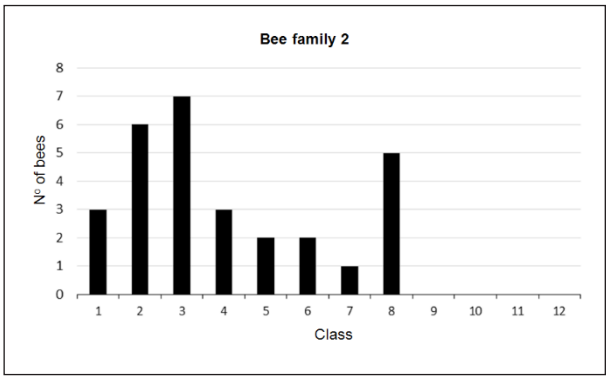

Figure 4. Variation curve of cubital index for bee family 2, for apiary from Rapesh

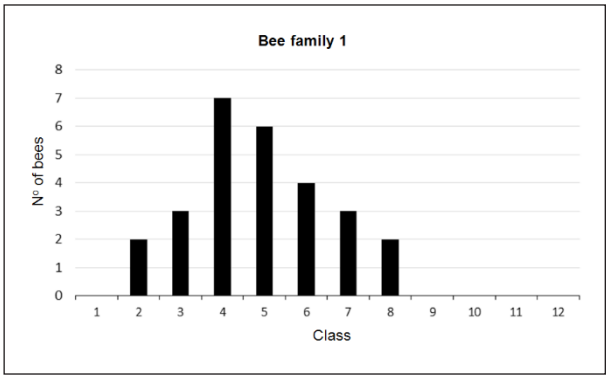

Figure 5. Variation curve of cubital index of bee family 1 for apiary from Gradeshnica

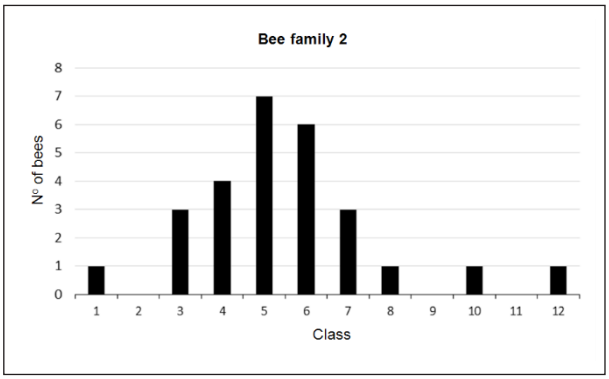

Figure 6. Variation curve of cubital index of bee family 2 for apiary from Gradeshnica

In Figures 3 and 4 where are presented bee families 1 and 2 from apiary in Rapesh. We can see that values of cubital index are scheduled in eight classes. The first bee family has normal distribution of values with one peak unlike the second bee family there are two peaks. Cubital indexes with average value of 2.09 and 1.97 are lowest from all investigated samples, but are similar to values given by Ruttner [4] for population of *Apis mellifera macedonica*.

From Figure 5 where it is presented bee family 1 from Gradeshnica, can be noticed that values of cubital index are scheduled in seven classes and have one peak. Like from the previous bee families the low cubital index from 2.13, shows that this bee family belongs to *Apis mellifera macedonica*.

From Figure 6 for bee family 2 from Gradeshnica can be noticed that values of cubital index are scheduled in nine classes and have one peak. Average value of cubital index is 2.25 which matches with values for *Apis mellifera macedonica* (Rutner [4]).

4. Conclusions

- From the previously presented results for bee families from Mariovo region we can conclude that the average values of cubital index is closest to the values published by Ruttner [4] for *Apis mellifera macedonica.*

- From the other side, the cubital index of researched bee families are lower and different from values published by Uzunov *et al.*, [7], for bee families from the territory of the Republic of Macedonia, which indicates the possible presence of different subspecies in the Mariovo region within the frame of the Macedonian honey bee.

- According to DAWINO standard, low cubital index is characteristic of *Apis mellifera mellifera* and *Apis mellifera caucasica*, but due to the geographic distance these subspecies are ruled out of the analysis.

5. References

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