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## EXTERIOR AND MORPHOMETRIC INDICATORS OF BRED BREEDS OF HONEY BEES OF KAZAKHSTAN

### ANNOTATION

The article presents the results of a study to determine the breed affiliation, exterior indicators, bred breeds of honey bees on the territory in the context of regions and zones of the Republic of Kazakhstan. The study of wings by morphometric method covered 3000 samples of front, right wings from 40 beekeeping farms. It has been established that representatives of three subspecies of honey bees (*A. m. carnica*, *A.m. carpatica*, *A.m. mellifera*) are mainly bred on the territory of Kazakhstan, honey bees of breeds are distributed in all zones of the country. *A. m. carnica* and from 86 to 96% of honey bees in bee colonies belong to the C line, and *A.m. carpatica* belongs to 53.5 to 97.7% of bee colonies in apiaries. On the territory of Kazakhstan, 61.6% belongs to *A.M. carnica*, 29.4% to *A.m. carpatica* and 9% to *A.m. mellifera* and other breeds. As a result of the study to determine the exterior data, it was found that the bred breeds of honey bees by the length of the proboscis, by the size of tergites, sternites, wings fully meet the requirements of the standards for bees of the evolutionary line C, which includes the breeds *A.m. carnica* and *A.m. carpatica*, they are Kazakhstan populations of these subspecies.

**Key words:** *morphometry, exterior, cubital index, dumbbell index, discoidal displacement*

**Introduction.** According to the results of the work carried out on breed testing by scientists beekeepers of Kazakhstan from 1964 to 1971, three main breeds of honey bees were identified for zoning in Kazakhstan: *A.m. carnica*, *A.m. carpatica*, *A.m. mellifera*. During the breed testing, gray mountain Caucasian, Italian, Carpathian, Carniolan honey bee, and European dark breeds, which were crossbred with local bees, participated [1].

The methodology of identification of morphometric features of honey bees is promising for population control, breeding of new types, lines [2]. In the modern world, there are two scientific research schools in the field of beekeeping that evaluate the breed affiliation of bees by morphometric characteristics: Russian and German, differing in methodological approaches [3]. The essence of the difference in the studies of the two schools is the use by the European school in calculating the cubital index by determining the natural value, the ratio of the proximal segment of the main vein of the 3 cubital cell and the discoidal, and the Russian school adopted the opposite ratio with a percentage conversion. According to other indices, studies are conducted in the same way in two schools [4].

The prevalence of honey bees (*Apis mellifera*) throughout the globe was described by the world's leading beekeeping scientists based on the results of their research [5, 6, 7, 8, 9, 10, 11]. Initially, based on morphological analysis, all subspecies of the honey bee were grouped into four well-differentiated evolutionary branches, or lines that corresponded to the geographical origin of the

subspecies: A - African line (subspecies); M – line "*Mellifera*" (subspecies of the western Mediterranean and Northwestern Europe), C – line "*Carnica*" (subspecies of Southeastern Europe and Eastern Mediterranean); O - line "Oriental" (subspecies of the Middle East and Western Asia) [5].

According to the modern classification, honey bees are divided into 30 subspecies belonging to six evolutionary lines. 11 subspecies of bees belong to the evolutionary line common in the African mainland, 9 subspecies that are common in eastern Europe and the Mediterranean belong to the C line, and 6 subspecies that are common in the Middle East are subject to the O line. On the territory of western and northern Europe, two subspecies from the M line are common, the remaining two subspecies of the two Z and Y lines are bred on the territory of Syria and Yemen [5, 6].

On the territory of eastern Europe and Belarus, 7 subspecies belonging to different evolutionary lines are often found: European dark bee (*A.m. mellifera*), Carpathian (*A.m. carpatica*), yellow Caucasian (*A.m. remipes Gerst*), Caucasian (*A.m. caucasica*), Carniolan honey bee (*A.m. carnica*), Italian (*A.m. ligustica*), Ukrainian steppe (*A.m. acervorum*) [12].

In Kazakhstan, the *A.m. carnica* subspecies is bred the most – currently, which make up about 61.6% of the number of bred honeybee breeds. Representatives of three breeds of honey bees are bred on the territory of our country: *A.m. carnica*, *A.m. carpatica*, *A.m. mellifera*, and there are also crossbred bees of representatives of different lines.

The purpose of the article was to present information material about the bred subspecies of honey bees in the territory of Kazakhstan.

**Materials and methods.** According to standard methods, 3000 samples of the front, right wings of the studied honey bees were selected from 40 apiaries from different regions of the country [13].

The samples were taken during the period of full activity of bees. They were fixed with ethyl medical alcohol and each batch was labeled indicating the numbers of the bee family [13].

The samples were taken according to the generally accepted method of Alpatov V. [14, 15, 16, 17], and the arrangement of lab preparation was carried out according to the method of Kartashov A. [18].

From the right front wing, legs, proboscis, hooks, sternite, tergite, the preparation was prepared by fixing on a transparent adhesive tape, scanned and received an electronic version according to the method of Kartashov A. [18]. They were scanned using an Epson V600 Photo scanner. The resolution of the images was 3200 dots per inch (image size: 5782x3946 pixels).

The exterior assessment of bees (proboscis length, number of hooks, tergite length and width, sternite length and width, wax mirror length and width, tarsal index of the right leg, length and width of the right wing) was carried out according to Alpatov's method in [14, 15, 16, 17] ( figure 1).

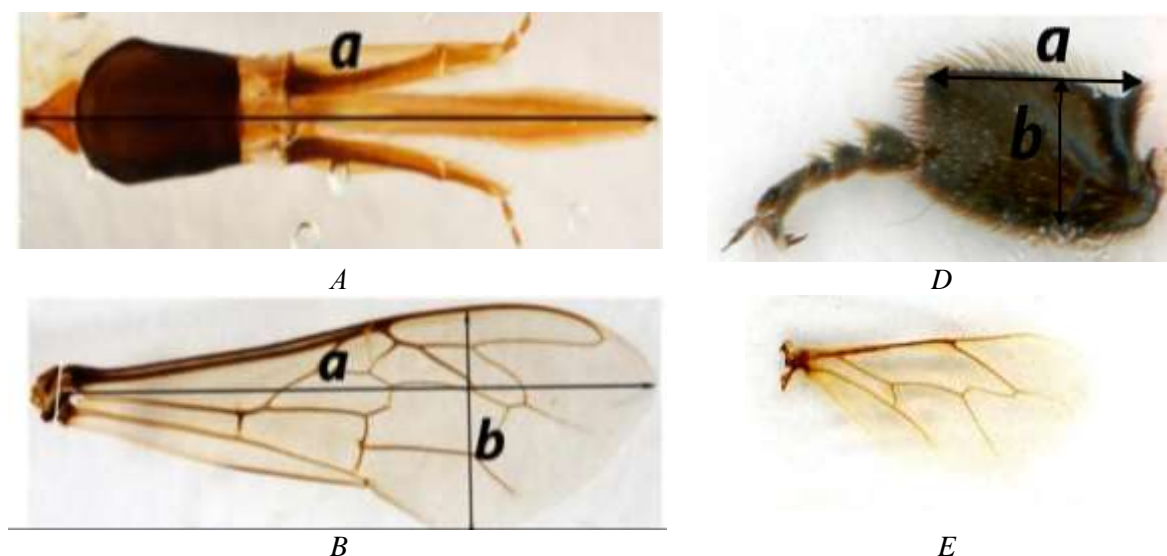




Figure 1 – A:proboscis length, B:front right wing: a – length, b- width,  
 C: tergite: a – length, b- width,  
 D: hind legs: a – length, b- width,E:small front wing (number of hooks),  
 F:sternite: a – length, b– width,wax mirror: c – length, d- width

The breed affiliation according to the index of the bee wing (cubital index, discoidal displacement, dumbbell index) was determined by the morphometric method according to A. Kartashov [18].

The obtained experimental material was processed according to the Microsoft Excel program based on the method of variational statistics according to the method of N.A. Plokhinsky [19].

**Results.**In the course of the study, the population of honey bees in Kazakhstan was studied by monitoring the number of apiaries, the presence of bred breeds, and the population of honey bees on the territory of Kazakhstan.

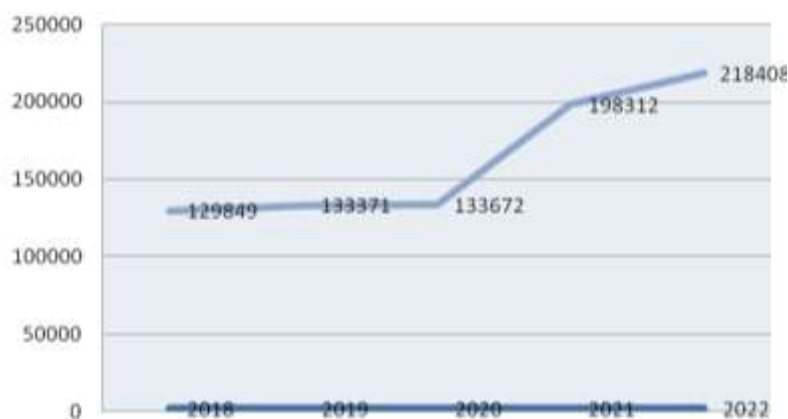


Figure 2 – Total number of families according to the Statistics Department of the Republic of Kazakhstan

Figure 3 shows the number of bee colonies in the context of the regions of Kazakhstan.

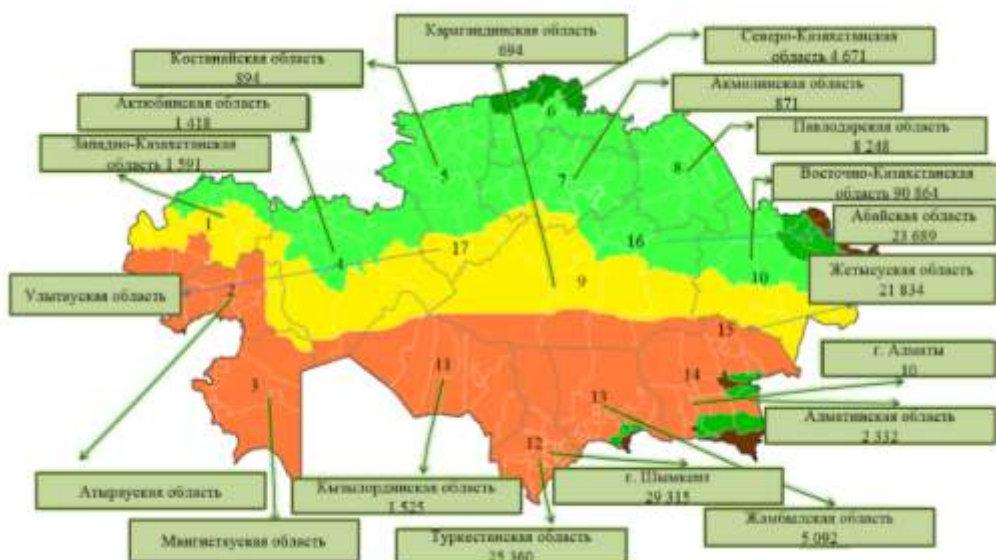


Figure 3 – Number of bee colonies in the context of natural and climatic zones of Kazakhstan

Currently, according to statistics, there are more than 218.4 thousand breeding families on the territory of our country [20]. 218408 bee families of Kazakhstan are located in the following order: the first place is occupied by the eastern region (East Kazakhstan, Abai region), where there are 114533 bee families or 52.45% of the total number. The second place is taken by the southern region (Zhambyl, Kyzylorda, Turkestan region, Shymkent), with 61292 bee families, which is 28.06%, the third place was taken by the south-eastern region (Zhetysu, Almaty) with the number of bee families 24176 or 11.07%, then the northern region (North Kazakhstan, Pavlodar, Kostanay) on the fourth (6.72%), the fifth – the Western region (West Kazakhstan, Aktobe) - 1.38% of bee colonies from the total number of bee colonies of the Republic of Kazakhstan. However, it should be noted that only in the territory of the East Kazakhstan region there are 90,864 bee colonies, which is 41.6% of all bee colonies in Kazakhstan.

Hence, it can be assumed that a large number of bee colonies and apiaries on the territory of eastern Kazakhstan are the result of the influence of the developed beekeeping of Altai and the early beginning (1786) of the development of beekeeping on the territory of present-day eastern Kazakhstan. The development of beekeeping in the south and south-east with a population of up to 85,468 bee colonies was apparently influenced by natural and climatic conditions and frequent importation of bee colonies from neighboring countries.

These indicators indicate the current state of the level of zoning of bred breeds: Carpathian, carnica, European dark bee, as well as unexplained populations of honey bees in Kazakhstan.

At the same time, it should be noted that bees are bred most of all on the territory of the republic in order to obtain honey products. Among the exemplary apiaries, the first place is occupied by the *A.m.carnica* breed with a population of 61.6% of the total number of bees, the second *A.m.carpatica* – 29.4%, and the remaining 9% is accounted for by other imported breeds and native local honey bees.

Studies were carried out to determine the breed affiliation and the percentage ratio of the number of studied cross bred bees in the context of breeds with the use of morphometric and molecular genetic modern methods.

In this regard, in the future, in order to establish an accurate, concrete picture of the number and abundance of breeds, populations, comprehensive studies will be conducted covering all bee apiaries, bee families in order to determine breeding areas in the context of breeds, ecotypes, intra-breeding lines of bees.

The result of taking into account the number of bee apiaries and bred breeds in the context of the regions, it was found that the first place is occupied by the *A.m.carnica* breed, which is adapted to the conditions of all 6 natural and climatic zones (desert, semi-desert, steppe, forest-steppe, foothill, mountain).

Taking into account the biological and physiological features of the bred breeds of honey bees, the breeding was determined: *A.M.carnica* and *A.M.carpatica*, which are acclimatized to warmer,

temperate climatic conditions, and the European dark breed of bees well adapted to cold conditions in the natural climatic zones of Kazakhstan with a relatively low temperature regime.

In Kazakhstan, the breeding area of the Carpathian and A.M.carnica bee breeds is expanding, which affects the increase in honey production, at the same time honey base plants for bees are improving, in this regard, natural and cultural honeybees, including oilseeds and fodder crops, have become widely used by bees. The necessary prerequisites are being created for the production of high-quality honey, which can successfully compete with the products of other countries.

According to the national statistics of the Republic of Kazakhstan, due to the state support for the development of beekeeping, there is an increase in the number of bee colonies, this was influenced by favorable natural and climatic conditions, relatively mild moderate temperature, wind speed and humidity in the summer period, as well as sufficient food supply for bees. Analyzing the data of the Department of Statistics of the Republic of Kazakhstan, the total number of hives in the regions over the past 3 years has increased by an average of 63.4%. However, beekeeping is poorly developed in the Mangistau and Atyrau regions. Compared to 2021, by the beginning of 2023, the number of bee colonies increased in the southern region by 36.8%, the remaining 4 regions, except for the central region, the number of 700 bee colonies in the western region increased to 2806 bee colonies in the eastern region, and in the central zone, the number of bee colonies decreased by 416 bee colonies.

To determine the presence of representatives of subspecies, 40 apiaries were studied, located in all natural and climatic zones, 12 regions of Kazakhstan, where 17967 bee colonies are bred. Of these, 14 bee apiaries are located in the steppe zone, 9 - in the forest-steppe zone, 4 - desert, 4 – semi-desert, 7 - foothill, 2 - mountain. The main directions of farms are honey and breeding. All farms in Kostanay and Pavlodar regions belong to the steppe zone, and in Almaty and East Kazakhstan regions apiaries are located in forest-steppe, steppe, mountain, foothill, desert, semi-desert zones. Of the 40 apiaries, 15 (37.5%) are stationary, where cultivated beekeepers are used for the further breeding of purebred families in the conditions of honey breeding farms. Table 1 shows the morphometric indicators of bees in the context of breeding zones.

Table 1 – Morphometric indicators of honey bees

Natural and climatic zone	Breed	Number of farms	Breed, %	Cubital index	Dumbbell index	Discoidal displacement	Tarsal index
1	2	3	4	5	6	7	8
Deserted	Carnica	2	92,6±2,59	2,785±0,06	1,08±0,01	3,91±0,25	57,09±0,565
	Carpathian	2	75,61±1,537	2,794±0,045	1,08±0,006	4,632±0,228	56,50±2,329
Semi - desert	Carnica	1	96,5±1,22	2,90±0,06	1,09±0,01	4,23±0,18	55,65±0,956
	different breeds	3		2,253 ±0,081	0,951 ±0,027	1,174±0,814	50,324 ±2,567
1	2	3	4	5	6	7	8
Steppe	Carnica	9	92,00±3,50	2,71±0,07	1,06±0,01	4,06±0,29	52,98±1,276
	Carpathian	3	97,70±1,476	2,946±0,104	1,11±0,012	4,650±0,259	57,33±0,663
Forest - steppe	Carnica	4	86,1±4,99	2,80±0,09	1,07±0,02	3,5±0,46	57,78±0,108
	Carpathian	2	58,6±2,45	2,4386±0,05	1,07±0,01	5,10±0,42	54,3±0,35
	Central Russian	2		2,274±0,018	1,06±0,033	3,574±1,209	59,08±1,893
Foothill	Carnica	5	92,90±1,49	2,66±0,04	1,08±0,01	3,84±0,16	57,52±0,55
	Carpathian	2	53,5±4,53	2,5088±0,49	1,061±0,01	4,00±0,21	55,6±0,38
Mountain	Carnica	1	95,10±1,82	2,78±0,05	1,08±0,01	3,71±0,14	58,77±0,57

The table shows the morphological characteristics of bees living in different natural and climatic conditions, showing variability depending on the latitude of the terrain and the vertical zoning of the regions. In this regard, it was necessary to study the morphological characteristics of bees in each region.

Bee samples for the study of morphological features were taken from bee colonies of the above localities and the following indices were measured with wings on the front right wings: cubital, dumbbell indices and discoidal displacement.

The difference in the cubital index of carnica between bees obtained in the forest-steppe zone with semi-desert was 0.10 (3.45%) and between steppe and semi-desert 0.19 (6.55%) and between foothill and semi-desert 0.24 (8.28%). Thus, the range of the cubital index of carnica, depending on the breeding zone, ranged from 0.10 to 0.24 and ranged from 2.66 to 2.90.

And for the Carpathian breed of bees, this indicator ranged from  $2.438 \pm 0.05$  to  $2.946 \pm 0.104$ . The lowest values for the cubital index were noted for crossbred bees in semi-desert ( $2.253 \pm 0.081$ ) and forest-steppe zones ( $2.274 \pm 0.0186$ ).

In morphometric analysis, the dumbbell index of the wings of the studied farms ranges on average from 0.951 (semi-desert zone) to 1.109 (steppe zone). During the study of the dumbbell index by breed, the following met the standard: carnica (from  $1.06 \pm 0.01$  to  $1.09 \pm 0.01$ ), Carpathian (from  $1.061 \pm 0.01$  to  $1.109 \pm 0.012$ ), and in crossbreeds this indicator ranges from  $0.951 \pm 0.027$  to  $1.060 \pm 0.033$ , which takes the index to the carnica breed index. In five zones, tarsal indices were the best for Ukrainian bees, only in the steppe zone they were better for Carpathians.

More contrasting interbreed differences are observed in the features of discoidal displacement. Purebred Carpathian bees have at least 80% of cases of positive bias. A high percentage of positive discoidal displacement in the Carpathian ( $4,00 \pm 0,21 - 5,10 \pm 0,42$ ) bee breeds.

26 carnica, 9 Carpathian and 5 with different breeds were studied from the general beekeeping with breed affiliation. Of all the beekeeping farms studied, bees have a high similarity with the characteristics of the Carpathian breed *A.m. carpatica* in the steppe zone ( $97.700 \pm 1.476$ ), and in the semi-desert zone ( $96.5 \pm 1.22$ ), the characteristics *A.m.carnica* were determined. In semi-desert and forest-steppe zones, hybridization of bees is observed. At the same time, the high variability is shown by the breed of carnica bees.

The analysis of exterior signs was carried out in 40 apiaries from all regions of Kazakhstan for 11 main morphometric signs of worker bees: proboscis length, number of hooks, tergite length, tergite width, sternite length, sternite width, wax mirror length, wax mirror width, tarsal index of the right leg, right wing length, right wing width (Table 2).

According to the research results, it was found that the number of hooks that affect the adjustment of hovering in flight in all breeds was in the range of 19.43-21.96. At the same time, the A.M. carnica breed had the smallest number of leads in the mountain and forest-steppe zones of 19.4-19.9, which requires further study.

The length and width of the tergite worker bees in all zones were within the standard. Wax mirrors are one of the main vital structures of the body. The percentage ratio is 1/3 of the width of the length of the wings. The ratio of length to width according to tergite was in the range from 42 to 48%. The dimensions and the ratio of length to width of wax mirrors affect the volume of wax produced by bees. According to tarsal indices, bees have a large value in desert ( $50,324 \pm 2,567$ ) and forest-steppe zones ( $59,084 \pm 1,893$ ), which affects long-term efficiency in the process of pollen collection.

The indicators of the average length of the proboscis, which is one of the main indicators for the bonitation of bees in the Carpathian breed ranges from  $6,072 \pm 0.084$  to  $6,462 \pm 0.035$ , and in the carnica breed it ranges from 6,184 to 6,29 mm, regardless of their habitat zone, according to the tarsal index and the width of the right wing there are minor deviations in breeding zones, and there are no significant differences in other indicators. A.M.carnica in the steppe zone tarsal index was 9.84% lower than in the mountainous zone.

**Conclusion.** It was found that in six natural and climatic zones of 15 regions of Kazakhstan, only breeds of honey bees *A.m. carnica*, *A.m. carpatica* are common in desert, steppe, forest-steppe and foothill zones, and *A.m. mellifera* and native local bees are bred in farms located in semi-desert and forest-steppe zones.

Taking into account the peculiarities of the natural and climatic zones of Kazakhstan, it is proposed to breed breeds of the C line in the conditions that they are acclimatized, namely, in hot

summer and warm temperate winter temperature conditions in zones, and more in cold temperature zones to breed European dark bee breeds and bees of the local population.

It has been established that the largest number of bees belongs to the *A.M.carnica* breed, which is bred by about 70% of farms, from all bee apiaries in Kazakhstan. There are cross bred representatives of the breed of the Ukrainian steppe, Caucasian, in scanty numbers. This indicates an unplanned and uncontrolled import of bees from different countries.

To carry out breeding, taking into account the selected directions, it is necessary to determine the level of purity and breeding value of the breeding group, queen bees and bee families.

As a result of the study to determine the exterior data, it was found that the bred breeds of honey bees by the length of the proboscis, by the size of tergites, sternites, wings fully meet the requirements of the standards for bees of the evolutionary line C, which includes the breeds *A.m. carnica* and *A.m. carpatica*, they are Kazakhstani populations of these subspecies. The average length of the proboscis of *carnica* was 6.22, were in the range from 6.18 to 6.29 mm, and the length of the proboscis of the Carpathians were a large range from 6.07 to 6.46 on average was 6.31 mm. The bred populations of the European dark bee breed in the eastern and southeastern regions belong to the evolutionary line M. The results of the studies confirmed that the European dark bee belongs to this line. When determining the cubital index of honey bees, the *carnica* breed averaged 2.77 with a deviation range from 4 to 4.7% (from 2.66 to 2.90), taking into account the indicators of all natural and climatic zones.

Thus, it has been established that the Kazakh population of the *A.M.carnica* breed is mainly acclimatized in the southern, southeastern and western regions, where a temperate climate is maintained throughout the year. Currently, work is underway to determine the adaptive and resistant to cold climates of the Karnik and Carpathian breeds, the Central Russian breed, mainly acclimatized to the conditions of the forest-steppe, with cold winter weather temperature regimes.

The use of morphometric methods for determining the breed affiliation makes it possible to determine the effectiveness of honey bees in acclimatized zones and relative high productivity of a particular breed.

Currently, breeding and zoning of the *A.m. carnica*, *A.m. carpatica*, *A.m. mellifera* breeds is effective and contributes to the development of beekeeping in Kazakhstan.

The possibility of importing representatives of other managed breeds, the preservation of local populations require further research to determine the possibility of breeding other imported populations of honey bees on the territory of Kazakhstan.

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Table 2 – Results of external indicators of worker bees in different climatic zones of Kazakhstan

Natural and climatic zone	Breed	n	Proboscis length	Number of leads	Tergite length	Tergite width	Sternite length	Width of sternite	Length of the wax mirror	The width of the wax mirror	Right wing length	Width of the right wing
Deserted	Carnica	2	6,184 ± 0,061	21,20±0,22	2,036±0,017	4,784±0,026	2,736±0,014	3,994±0,023	1,467±0,014	2,310±0,020	9,326±0,030	3,089±0,013
	Carpathian	2	6,072±0,084	21,33±1,202	2,703±0,078	4,768±0,058	3,267±0,131	4,319±0,133	1,761±0,067	2,717±0,074	9,142±0,035	3,723±0,182
Semi - desert	Carnica	1	6,195±0,049	20±2,0	2,008±0,029	4,812±0,028	2,772±0,089	4,023±0,110	1,446±0,004	2,252±0,092	9,2±0,164	2,992±0,028
	different breeds	3	6,086 ± 0,201	20,250 ± 0,590	2,559 ± 0,019	5,727 ± 0,051	3,358 ± 0,054	5,318 ± 0,140	1,334 ± 0,030	2,456 ± 0,082	10,025 ± 0,186	3,514 ± 0,086
Steppe	Carnica	9	6,199±0,057	21,667±0,182	2,197±0,017	4,849±0,056	2,729±0,012	4,225±0,023	1,484±0,009	2,322±0,019	9,305±0,029	3,158±0,030
	Carpathian	3	6,462±0,035	21,967±0,232	2,100±0,023	4,760±0,069	2,679±0,022	4,064±0,034	1,525±0,019	2,408±0,022	9,303±0,036	3,444±0,041
Forest - steppe	Carnica	4	6,231±0,077	19,933±0,230	2,049±0,062	4,267±0,089	2,715±0,041	4,180±0,026	1,407±0,051	2,235±0,024	9,792±0,054	3,566±0,031
	Carpathian	2	6,3±0,05	22±0,34	2,15±0,01	4,6±0,07	2,81±0,02	4,41±0,02	1,21±0,01	2,13±0,02	9,0±0,02	3,2±0,06
	Central Russian	2	6,455±0,046	20,333±0,221	2,148±0,020	4,662±0,028	2,724±0,013	4,058±0,027	1,499±0,008	2,365±0,015	9,549±0,042	3,448±0,042
Foothill	Carnica	5	6,29±0,02	20,50±0,42	2,20±0,01	4,79±0,02	2,83±0,03	4,65±0,03	1,27±0,01	2,28±0,02	9,14±0,04	3,24±0,02
	Carpathian	2	6,4±0,03	20±0,31	2,15±0,02	4,7±0,04	2,9±0,03	4,57±0,03	1,28±0,01	2,4±0,02	9,0±0,02	3,3±0,06
Mountain	Carnica	1	6,26±0,03	19,43±0,53	2,14±0,01	4,63±0,03	2,81±0,02	4,40±0,02	1,21±0,01	2,13±0,02	8,97±0,03	3,19±0,01

## REFERENCES

- 1 Rib, R.D. Pchelovodu Kazahstana [Tekst] / R.D. Rib // - Ust'-Kamenogorsk: "Media Al'jans", 2016. - 408 s.
- 2 Krivcov, N.I. Identifikacija vnutrividovyh taksonov pchely medonosnoj / N.I. Krivcov // Pchelovodstvo. – 2003. – №8. – S. 13-15.
- 3 Kolbina, L.M. Komp'juternye programmy dlja izuchenija morfometrii kryla / L.M. Kolbina S.N. Nepejvoda //Pchelovodstvo. - 2004. -№ 6. – S.18 – 19.
- 4 Shareeva, Z.V. Morfo-fiziologicheskie osobennosti pchel severozapadnogo rajona Respubliki Bashkortostan / Z.V. Shareeva // Pchelovodstvo XXI. Temnaja pchela (*Apis mellifera* L) v Rossii: materialy mezhdunarodnoj konferencii. Moskva, 2008. - S. 384-387.
- 5 Ruttner, F. Biogeography and taxonomy of honey bees / F. Ruttner. – Berlin, Germany: Springer-Verlag, 1988. – 284 p.
- 6 Sheppard, W. S., Meixner, M.D. *Apis mellifera pomonella*, a new honeybee subspecies from central Asia. *Apidologie* -2003. -№ 34, S. 367–375.
- 7 Garnery, L., Solignac, M., Celebrano, G., Cornuet, J.-M. A simple test using restricted PCR-amplified mitochondrial DNA to study the genetic structure of *Apis mellifera* L. *Experientia* -1993. № 49, S. 1016–1021.
- 8 Sheppard, W. S., Arias, M. C., Grech, A., Meixner, M. D. (1997) *Apis mellifera ruttneri*, a new honey bee subspecies from Malta. *Apidologie* 28, 287–293
- 9 Kandemir, İ., Özkan, A., Fuchs, S. Reevaluation of honeybee (*Apis mellifera*) microtaxonomy: a geometric morphometric approach. *Apidologie* - 2011. № 42, S. 618–627.
- 10 Meixner, M.D., Pinto, M.A., Bouga, M., Kryger, P., Ivanova, E., Fuchs, S. Standard methods for characterising subspecies and ecotypes of *Apis mellifera*. *J. Apic. Res.* – 2013. № 52, S. 1–28.
- 11 Chen, C., Liu, Z., Pan, Q., Chen, X., Wang, H., Guo, H., Liu, S., Lu, H., Tian, S., Li, R., Shi, W. Genomic analyses reveal cemographic history and temperate adaptation of the newly discovered honey bee subspecies *Apis mellifera sinisxinyuan* n. ssp. *Mol. Biol. Evol.* – 2016. № 33, S.1337–1348.
- 12 Marina, D.M. et al. *Apis mellifera mellifera* in eastern Europe - Morphometric variation and determination of its range limits. *Apidologie.* – 2007. №38(2) DOI:10.1051/apido:2006068.
- 13 Standard methods for *Apis mellifera* research.  
<https://coloss.org/activities/coreprojects/beebook/volume-1/>
- 14 Alpatov, V.V. Biometricheskaja harakteristika srednerusskoj i ukrainskoj pchely. *Revue Zoologique Russe.* 1927. - T. VII(4). S. 31-74.
- 15 Alpatov, V.V. K poznaniju izmenchivosti medonosnoj pchely. III. Kubital'naja jachejka na kryl'jah vidov roda *Apis* i eè diagnosticheskoe i jevoljucionnoe znachenie. *Revue Zoologique.* 1935. T. 14(4). S. 664-673.
- 16 Alpatov, V.V. Porody medonosnoj pchely kak osnova eè plemennogo razvedeniya. M.: Izdanie MGU. 1945. 56 s.
- 17 Alpatov, V.V. Porody medonosnoj pchely i ih ispol'zovanie v sel'skom hozjajstve. M.: Izd-vo MOIP. 1948. 183 s.
- 18 Kartashov, A. Instruktivno-metodicheskie materialy po rabote s programmoj dlja opredelenija porodnoj prinadlezhnosti pchel medonosnyh *Apis Mellifera* po zhilkovaniju kryla «Poroda po kryl'jam». – L., 2013.
- 19 Plohinskij, N.A. Rukovodstvo po biometrii dlja zootehnikov. - M., - 1969. - 256 s.
- 20 Informacionno – analiticheskaja sistema Bjuro nacional'noj statistiki Agentstva po strategicheskomu planirovaniju i reformam RK.  
<https://taldau.stat.gov.kz/ru/NewIndex/GetIndex/2972846?keyword>

## ТҮЙІН

Мақалада Қазақстан Республикасының облыстары мен аймақтарында тұқымдық тиесілігін анықтау бойынша зерттеу нәтижелері, бал араларының өсірілетін тұқымдарының экстерьерлік көрсеткіштері келтірілген. Морфометриялық зерттеу әдістері бойынша 40 ара шаруашылығынан 3000 дана алдыңғы, оң қанат үлгілері зерттелді. Қазақстан аумағында негізінен бал араларының үш түрінің өкілдері өсірілетіні анықталды (*A.m.carnica*, *A.m. carpatica*, *A.m.mellifera*), еліміздің барлық аймақтарында *A.m.carnica* тұқымдарының бал аралары таралған және ара колонияларындағы бал араларының 86-96%-ы С линиясына жатады, ал *A.m.carpatica* тұқымына өсірілетін ара шаруашылықтарының 53,5-тен 97,7%-на дейін тиесілі. Қазақстан аумағында 61,6% - *A.m.carnica*, 29,4% - *A. m. carpatica* және 9% - *A.m. mellifera* және басқа да тұқымдарға жатады.

Экстерьерлік көрсеткіштерді зерттеу нәтижесінде бал араларының өсірілген тұқымдары тұмсығының ұзындығы, тергиттердің, стерниттердің, қанаттардың мөлшері бойынша *A.m.carnica* және *A.m.carpatica* тұқымдары жататын С эволюциялық линиясының аралары үшін стандарт талаптарына толық жауап беретіні анықталды, олар осы кіші түрлердің қазақстандық популяциялары болып табылады.

#### РЕЗЮМЕ

В статье приведены результаты исследования по определению породной принадлежности, экстерьерные показатели, разводимых пород медоносных пчел на территории в разрезе областей и зон Республики Казахстана. Были исследованы 3000 образцов передних, правых крыльев из 40 пчеловодных хозяйств по морфометрическим методам. Установлено, что на территории Казахстана в основном, разводятся представители трех подвидов медоносных пчел (*A.m. carnica*, *A.m. carpatica*, *A.m. mellifera*), во всех зонах страны распространены медоносные пчелы пород *A.m. carnica* и от 86 до 96% медоносных пчел в пчелосемьях относится к линии С, а *A.m. carpatica* принадлежит от 53,5 до 97,7% пчелосемей разводимых хозяйствах по пчеловодству. На территории Казахстана 61,6% относится к *A.m. carnica*, 29,4% - *A.m. carpatica* и 9% *A.m. mellifera* и другим породам. В результате исследования по определению экстерьерных данных установлено, что разводимые породы медоносных пчел по длине хоботка, по размерам тергитов, стернитов, крыльев полностью отвечают требованиям стандартов для пчел эволюционной линии С, куда относится породы *A.m. carnica* и *A.m. carpatica*, они являются Казахстанскими популяциями этих подвидов.