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Eidonomy of *Apis mellifera* Workers and Drones in Apiaries

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Abstract: In modern ecosystems, the increasing anthropogenic load, the absence or an insufficient number of scientifically based integrated programs and measures for the reproduction and distribution of local bee populations, as well as the preservation of their habitat territories; unsystematic hybridization leads to the transformation of the quantitative and qualitative composition of bees in the regions. In connection with the presented facts, it is obvious that complex morphological studies of honey bees are becoming particularly relevant at the present stage of beekeeping development, in order to identify the preservation of populations and the potential for the development of beekeeping. It was found that only in 10 districts is the predominant number of worker bees of the central Russian subspecies. The evaluation of drone morphotypes showed that only 7 districts with a predominant number of the Central Russian subspecies (morphotypes: O and Is) can be distinguished: Volzhsky, Isaklinsky, Kinel Cherkassky, Koshkinsky, Krasnoarmeysky, Pokhvistnevsky, and Sergievsky districts. Data on the assessment of worker bees in the forest steppe zone allowed us to identify 8 districts where they more closely corresponded to the central Russian subspecies: Volzhsky, Syzran, Koshkinsky, Sergievsky, Chelno-Vershinsky, Kamyshlinsky, Pokhvistnevsky, and Isaklinsky districts. Assessment of morphotypic structure and morphometric features revealed a tendency to change the taxonomic affiliation of native bees. These changes are the result of the artificial relocation of honey bees of various geographical origins to the territory of the samara region. The discovery of drones of the central Russian subspecies suggests the presence of purebred queens, which is some potential for restoring the historically established population structure of bees in the region by gradually creating areas and zones of purebred breeding.

Keywords: Honey Bee, Worker Bee, Drone, Morphotype, Morphometric Measurements, Samara Region

Science Publications

Introduction

Beekeeping being the most ancient mankind activity, in the modern structure of the Agro Industrial Complex (AIC) of the countries remains one of the main industries aimed at the selection of economical traits of honey bees (*Apis mellifera*). A distinctive feature of beekeeping from other branches of animal husbandry is that selection and breeding activities are carried out on the genetic material of naturally formed taxonomic groups (subspecies or races). At the same time, the bee was formed as a species about 50 million years ago, during which it evolved and spread in conjunction with the nature and climate of certain landscape zones (Chugreev *et al*., 2021; Borodachev *et al*., 2019; Baimukanov, 2022a-b).

As a result, a large number of naturally formed subspecies (called by specialists a breed) was formed, subdivided into many populations, which, unlike the breeds of other "cultured" animals, do not differ from their wild ancestors that lived freely in the natural environment. It is known that in modern ecosystems there is an increasing technogenic load, the accumulation of ecotoxic ants of various origins, the absence or an insufficient number of scientifically grounded comprehensive programs and measures for the reproduction and distribution of local bee populations, as well as the preservation of their habitats; unsystematic hybridization and the spread of various diseases lead to the transformation of the quantitative and qualitative bee composition in the regions. In turn, this situation may cause a decrease in the volume of beekeeping products, a violation of the unique centuries old population systems of honeybee subspecies, which is negatively reflected both in the intensity and efficiency of the crop and livestock sectors of agriculture (Büchler *et al*., 2010; Büchler *et al*., 2013).

In connection with the presented facts, it is obvious that complex morphological studies of bees acquire special relevance at the present stage of beekeeping development to identify the safety of populations and the development capacity of beekeeping.

The territory of the samara region is located in the southeast of the European part of Russia, between 47°55′ and 52°35′ east longitude and between 51°47′ and 54°41′ north latitude. The southernmost point of the region lies on the border with Kazakhstan (51°47′N and 50°47′E) and the northernmost point is on the border with the Republic of Tatarstan (54°41′N and 51°23′E). The extreme western point is on the border with the Ulyanovsk region (53°22′N and 47°55′E) and the extreme eastern point is on the border with the Orenburg region (54°20′N and 52°35′E). The climate of the samara region is middle latitudes continental formed under the influence of land, due to its location in the southeastern part of European Russia (Mannapov *et al*., 2017; Kovačić *et al*., 2020; Mannapov *et al*., 2022; Komlatskiy, 2016; Jacques *et al*., 2020; De Smet *et al*., 2017; Li *et al*., 2018).

Despite the lack of available research on the topic of the presented work, this issue remains relevant for the Samara population of the central Russian honeybee subspecies, since scientifically grounded, fundamental work in this direction has not been carried out on the territory of the Samara region before.

Aim of the Research

The research aim was to identify the species of worker bees and drones, based on an assessment of morphology.

Materials and Methods

The material of the study was worker bees and drones from apiaries of 27 districts (Alekseevsky, Bezenchuksky, Bogatovsky, Bolsheglushitsky, Bolshechernigovsky, Borsky, Volzhsky, Elkhovsky, Isaklinsky, Kamyshlinsky, Kinelsky, Kinel Cherkassky, Plyavlinsky, Koshkinsky, Krasnoarmeysky Pokhvistnevsky, Privolzhsky, Sergievsky, Stavropol, Syzransky, Khvorostyansky, Chelno Vershinsky, Shentalinsky, Shigonsky).

In each district, 8-10 apiaries were studied, where 5 bee colonies were selected with a selection of 30 worker bees and drones. The sample size was 75,000 individuals or 1250 colonies (SAAB, 2016).

The morphology of honey bees was assessed according to the standard method. 10 standard exterior parameters were identified (proboscis length; length and width of tergite 3 and sternite 3; length and width of the right front wing; cubital and tarsal indices, discoidal displacement) and the color of the cuticle of bees (morphotype) was assessed.

The killing of bees was carried out in a killing bottle "charged" with a 10% ammonia solution. An ordinary wide mouth jar (0.5 l capacity) with a tight-fitting lid to prevent evaporation was used for the killing device (Figs. 1-2). Cotton wool was fixed under the lid, on which the killing solution was applied. The sedation occurred within about 30 min.

Subsequently, the insects were shaken out of the bottle, and pierced with an entomological pin No. 2 (manufactured by ENTO sphinx S.R.O., Czech Republic) in the thoracic region, according to the entomological requirements for the design of insects.

For long-term storage of bees, labeling was done. For the analysis of quantitative data, we used the pc program Statistica version 6.1., Copyright E9 Stat Soft, lnc. 1984-2004 and microsoft office excel 2007 software (Mannapov *et al*., 2022).

Fig. 1: Samples of collections of honey bees: 1-workers

Fig. 2: Sample of entomological pin (photo by A.V. Sattarova)

Research Results

In 27 research districts, only 10 were found to have a predominant number of worker bees with cuticle coloration characteristic of the central Russian subspecies (O and e), while the morphotype O was intravariational (O (ч) and O (c)): Volzhsky, Isaklinsky, Kamyshlinsky, Kinel-Cherkassky, Koshkinsky, Krasnoarmeisky, Pokhvistnevsky, Sergievsky, Syzransky and Kinel-Cherkassky (Fig. 3).

During the identification of the morphotype structure of drones, high heterogeneity of tergite coloration was also revealed and four variants of morphotypes were identified: O, I_s, I, 1R (Fig. 4).

Analysis of the morphotypes of drones showed that it is possible to distinguish only 7 regions with a predominant number of individuals of the Central Russian subspecies (morphotypes: O and I_s): Volzhsky, Isaklinsky, Kinel Cherkassky, Koshkinsky, Krasnoarmeisky, Pokhvistnevsky, and Sergievsky districts.

Evaluation of classical morphometric characteristics of honey bees remains the main zootechnical measure in beekeeping during a bonitation. As a result, we carried out the appropriate measurements and obtained results for bee colonies of all four soil landscape zones of the samara region.

The data of morphometric measurements of workers in the forest steppe zone made it possible to identify 5 regions where they most closely corresponded to the standard of the central Russian subspecies, *Apis mellifera*: Volzhsky, Syzransky, Koshkinsky, Sergievsky, Chelno Vershinsky.

Parameters of workers in this area were as follows, M ± m: Proboscis length, mm: (6.23±0.05); length of the 3rd tergite, mm: (2.34±0.02); width of the 3rd tergite, mm: (4.89±0.01); length of the 3rd sternite, mm: (3.13±0.02); width of the 3rd sternite, mm: (4.86±0.02); tarsal index,%: (53.8±1.5); length of the right front wing, mm: (9.8±0.02); width of the right front wing, mm: (3.35±0.01); cubital index, %: (62.6±1.9); negative discoidal displacement was found on average in 59% of bees (Table 1).

The results of measurements of drones of the forest steppe zone made it possible to identify 6 districts where they most completely corresponded to the standard of the central Russian subspecies: Volzhsky, Syzransky, Koshkinsky, Sergievsky, Chelno Vershinsky, Kamyshlinsky districts. Morphometric traits of drones, M ± m: Cubital index, %: (63.2±1.1); negative discoidal displacement was revealed on average in 64% of individuals; the brown coloration of chitin was found in 61% of individuals. Bees from other areas of this district met the standard by 40% or less.

Studies of bees from six districts of the transitional (buffer) zone revealed only one district: Kinel Cherkassky, where the bees most closely corresponded to the exterior standard of the central Russian subspecies. The results of morphometric studies of worker bees were as follows, M ± m: Proboscis length, mm: (6.30±0.02); length of the 3rd tergite, mm: (2.25±0.01); width of tergite 3, mm: (4.80±0.02); length of the 3rd sternite, mm: (3.10±0.03); width of the 3rd sternite, mm: (4.80±0.02); tarsal index, %: (52.4±1.2); length of the right front wing, mm: (9.31±0.02); width of the right front wing, mm: (3.30±0.02); cubital index,%: (60.8±1.8); negative discoidal displacement was recorded on average in 50.5% of individuals. The average values of the drones' parameters in the same district mostly corresponded to the standard of central Russian bees, M ± m: Cubital index, %: (65.5±0.9); negative discoidal displacement was revealed on average in 65.5% of individuals; the brown color of chitin was identified in 62% of bees. In the rest of the areas, drones met the standard by less than 50%.

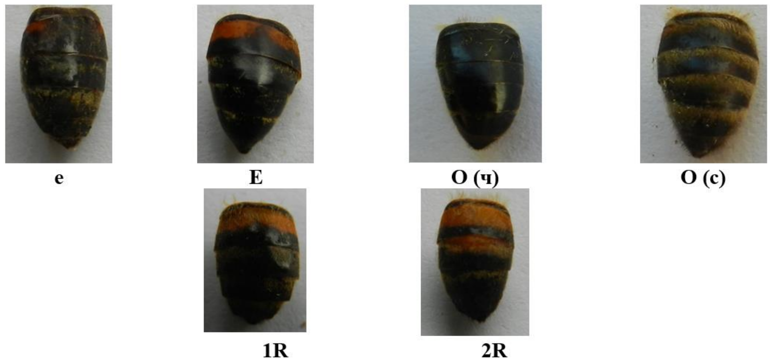

Fig. 3: Morphotypes of worker bees found in the samara region

Fig. 4: Morphotypes of drones found in the samara region

Table 1: Results of morphometric measurements of worker bees by 10 signs distributed in the studied natural zones of the samara region

	Sign														
	Proboscis length, mm			Length of the 3rd tergite, mm			Width of the 3rd tergite, mm			Length of the 3rd sternite, mm			Width of the 3rd sternite, mm		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %
Forest steppe zone															
Volzhsky	6.25±0.05	6.0-6.5	1.8	2.4±0.03	2.0-2.6	8.3	4.8±0.03	4.5-5.0	5.6	3.0±0.02	2.9-3.1	4.0	4.70±0.03	4.5-4.9	2.9
Elkhovsky	6.69±0.01	6.4-7.1	5.8	2,4±0,02	2.1-2.6	6.2	4.4±0.01	4.3-4.7	4.6	2.9±0.01	2.9-3.0	3.1	4.41±0.02	4.3-4.5	1.9
Isaklinsky	6.62±0.07	6.8-7.2	2.3	2.2±0.02	2.0-2.6	7.0	4.7±0.03	4.5-5.0	5.1	3.0±0.02	2.9-3.2	4.3	4.71±0.05	4.4-4.9	3.0
Kamyshlinsky	6.48±0.03	6.1-6.8	3.6	2.2±0.01	2.1-2.4	5.7	4.6±0.02	4.4-4.9	4.9	3.1±0.03	2.9-3.2	4.3	4.76±0.02	4.5-5.0	3.8
Klyavlinsky	6.58±0.02	6.5-6.7	6.9	2.4±0.03	6.1-6.8	3.6	2.2±0.01	2.1-2.4	5.1	3.0±0.01	2.9-3.1	3.3	4.60±0.02	4.3-4.9	4.5
Koshkinsky	6.30±0.05	6.0-6.7	6.2	2.3±0.02	2.1-2.6	6.9	4.6±0.02	4.4-4.8	4.8	3.1±0.01	2.9-3.2	3.3	4.81±0.01	4.6-4.9	2.8
Krasnoyarsk	6.52±0.07	6.0-7.0	7.4	2.4±0.05	2.0-2.6	7.2	4.6±0.01	4.3-4.8	5.0	3.0±0.02	2.9-3.1	3.3	4.50±0.03	4.3-4.7	3.1
Pokhvistnevsky	6.38±0.05	6.0-6.7	3.7	2.2±0.01	2.1-2.4	4.5	4.9±0.01	4.7-5.0	2.5	3.0±0.03	2.9-3.1	1.5	4.92±0.01	4.8-5.0	2.0
Sergievsky	6.5±0.01	6.1-7.1	5.8	2.3±0.01	2.0-2.6	7.2	4.8±0.01	4.8-4.9	1.6	3.1±0.01	3.0-3.2	1.9	4.80±0.02	4.7-5.0	3.2
Stavropolski	6.59±0.03	6.0-7.1	6.1	2.2±0.02	2.0-2.4	5.6	4,6±0,03	4.3-4.9	4.8	2.9±0.01	2.9-3.0	1.5	4.91±0.05	4.8-5.0	3.6
Syzransky	6.32±0.03	5.9-6.7	5.8	2.3±0.02	2.1-2.5	5.7	4.9±0.01	4.8-5.0	2.2	3.1±0.01	3.0-3.2	1.9	4.82±0.03	4.7-5.0	3.2
Chelno-Vershinsky	6.39±0.04	6.0-6.7	3.9	2.2±0.02	2.0-2.4	5.8	4.9±0.01	4.8-4.9	1.5	3.0±0.02	2.9-3.2	3.3	4.93±0.02	4.7-5.0	3.2
Shentalinsky	6.57±0.06	6.0-7.0	6.7	2.3±0.01	2.1-2.4	5.9	4.8±0.02	4.6-4.9	3,5	2.9±0.01	2.9-3.0	1.5	4.54±0.03	4.3-4.8	4.1
Shigonsky	6.73±0.04	6.2-7.2	6.5	2.4±0.03	2.2-2.5	5.8	4.5±0.04	4.4-4.7	4.0	3.0±0.01	2.9-3.1	3.3	4.42±0.02	4.3-4.6	3.4
	Sign														
	Tarsal index, %			Length of the right front wing, mm			Width of the right front wing, mm			Qubital index, %			Discoidal displacement, %		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	+	-	0
Volzhsky	54.4±1.5	50.0-58.8	5.1	9.5±0.01	9.0-10	3.5	3.1±0.01	3.0-3.2	1.8	59.6±2.3	55.4-65.0	5.3	22.8	60.2	17.0
Elkhovsky	56.6±1..1	55.8-58.0	3.2	9.1±0.02	9.0-9.4	1.6	3.2±0.02	3.0-3.4	2.1	50.3±2.5	47.6-54.0	4.8	67.0	12.9	20.1
Isaklinsky	55.0±1.8	52.2-59.0	6.7	9.6±0.06	9.1-10	3.4	3.3±0.01	3.1-3.5	2.5	59.0±1.9	57.8-62.0	3.0	42.9	19.3	37.8
Kamyshlinsky	54.9±1.5	52.8-56.7	3.5	9.5±0.02	9.0-9.8	2.6	3.4±0.02	3.1-3.5	2.0	59.2±1.7	54.9-62.9	6.6	36.1	50.5	13.4
Klyavlinsky	57.6±2.4	52.3-59.6	7.4	9.2±0.02	9.0-9.4	3.1	3.2±0.01	3.2-3.3	1.9	50.5±3.0	45.0-57.0	9.2	42.8	24.7	32.5
Koshkinsky	54.5±1.9	52.1-56.7	4.3	9.6±0.01	9.1-10	3.3	3.3±0.01	3.1-3.5	1.6	59.6±2.5	54.7-64.4	8.6	34.9	42.8	22.3
Krasnoyarsk	54.5±2.1	52.3-56.0	3.0	9.3±0.03	9.0-9.7	3.0	3.4±0.01	3.3-3.6	1.9	50.3±2.2	44.5-56.8	10.0	43.0	18.3	38.7
Pokhvistnevsky	56.0±1.6	53.6-58.0	5.6	9.5±0.03	9.0-10	3.6	3.4±0.02	3.3-3.5	1.8	59.3±2.8	53.0-65.0	7.6	26.5	20.3	53.2
Sergievsky	54.3±1.4	50.0-57.1	4.1	9.7±0.01	9.2-10	3.1	3.4±0.02	3.3-3.5	1.8	61.1±2.4	57.5-65.0	5.8	30.9	30.8	38.3
Stavropolski	58.0±0.9	55.6-59.0	3.8	9.3±0.02	9.0-9.6	3.5	3.3±0.03	3.0-3.5	2.0	49.4±2.1	46.0-53.0	6.0	58.8	10.7	30.5
Syzransky	55.2±1.7	52.9-58.7	4.4	9.3±0.01	9.0-9.6	3.3	3.3±0.02	3.1-3.5	1.7	60.8±1.9	57.5-65.0	5.8	23.2	32.6	44.2
Chelno-Vershinsky	54.8±1.5	51.8-57.0	5.6	9.6±0.01	9.0-10	3.5	3.2±0.02	3.0-3.4	1.9	57.1±2.0	53.6-61.0	3.5	42.3	30.2	27,5
Shentalinsky	58.0±1.9	56.6-59.1	3.2	9.3±0.02	9.0-9.5	1.7	3.2±0.02	3.0-3.3	2.1	50.5±1.6	46.0-53.7	7.2	46.2	13.8	40.0
Shigonsky	57.1±2.4	55.8-59.0	4.6	9.2±0.01	9.0-9.4	1.9	3.2±0.01	3.1-3.3	1.5	49.6±2.1	47.2-52.3	6.3	62.3	11.0	26.7
Transition (buffer) zone															
	Sign														
	Proboscis length, mm			Length of the 3rd tergite, mm			Width of the 3rd tergite, mm			Length of the 3rd sternite, mm			Width of the 3rd sternite, mm		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %
Bezenchuk	6.57±0.02	6.2-7.0	3.0	2.2±0.03	2.0-2.4	3.8	4.5±0.01	4.4-4.6	2.2	3.0±0.02	2.9-3.1	1.9	4.65±0.02	4.4-4.8	2.8
Bogatovsky	6.50±0.02	6.1-7.1	5.1	2.3±0.03	2.1-2.5	4.0	4.5±0.01	4.4-4.6	2.1	3.0±0.02	2.9-3.1	1.8	4.66±0.03	4.3-4.9	3.3
Borsky	6.61±0.03	6.2-7.1	4.9	2.3±0.03	2.1-2.5	3.9	4.5±0.02	4.4-4.6	2.1	2.9±0.01	2.9-3.0	1.4	4.71±0.02	4.5-4.9	2.6
Kinelsky	6.41±0.02	6.2-6.7	4.8	2.4±0.04	2.1-2.6	4.0	4.6±0.03	4.4-4.8	1.7	3.0±0.02	2.9-3.1	1.8	4.73±0.02	4.4-4.9	3.1
Kinel-Cherkassky	6.30±0.02	6.0-6.8	4.4	2.4±0.01	2.1-2.6	4.1	4.8±0.02	4.6-5.0	3.2	3.1±0.03	3.0-3.1	1.5	4.80±0.02	4.6-5.0	2.7
Privolzhsky	6.62±0.03	6.2-7.1	5.0	2.2±0.02	2.0-2.4	3.9	4.6±0.02	4.4-4.8	3.0	3.0±0.02	2.9-3.1	2.0	4.44±0.01	4.4-4.5	1.2

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Table 1: Continue

	Sign														
	Tarsal index, %			Length of the right front wing, mm			Width of the right front wing, mm			Qubital index, %			Discoidal displacement, %		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	+	-	0
Bezenchuk	55.8±0.9	53.3-57.4	2.7	9.5±0.04	9.1-9.7	1.8	3.2±0.01	3.0-3.3	2.7	49.0±0.8	47.3-53.1	3.8	64.2	12.8	23.0
Bogatovsky	57.3±0.7	54.2-58.4	2.5	9.3±0.03	9.0-9.6	2.0	3.2±0.02	3.0-3.4	3.4	56.0±1.7	49.7-61.3	4.2	74.2	11.0	14.8
Borsky	57.7±1.6	55.2-59.8	2.8	9.4±0.03	9.1-9.8	2.2	3.2±0.02	3.1-3.3	3.2	53.0±1.5	51.0-55.1	3.0	62.7	12.3	25.8
Kinelsky	56.6±1.2	53.0-59.8	3.2	9.4±0.04	9.1-9.8	2.6	3.3±0.03	3.1-3.5	4.9	54.5±2.0	48.0-60.8	5.2	51.2	13.6	35.2
Kinel-Cherkassky	52.4±1.2	52.0-56.1	2.7	9.31±0.02	9.1-10.0	3.5	3.3±0.02	3.0-3.5	5.1	60.8±1.8	57.0-63.8	3.1	34.0	50.5	15.5
Privolzhsky	57.1±1.8	54.1-59.0	4.5	9.3±0.02	9.0-9.6	1.4	3.2±0.02	3.1-3.4	4.0	54.7±1.7	52.3-57.0	2.2	67.2	20.6	12.2
Steppe zone															
	Sign														
	Proboscis length, mm			Length of the 3rd tergite, mm			Width of the 3rd tergite, mm			Length of the 3rd sternite, mm			Width of the 3rd sternite, mm		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %
Alekseevsky	6.68±0.02	6.3-7.1	5.0	2.1±0.01	2.0-2.2	2.3	4.4±0.01	4.4-4.5	1.3	3.0±0.02	2.9-3.1	2.2	4.50±0.02	4.4-4.7	2.5
Bolsheglushitsky	6.43±0.03	6.1-6.8	4.3	2.3±0.03	2.0-2.6	4.8	4.5±0.02	4.4-4.7	3.0	3.0±0.02	2.9-3.0	1.9	4.43±0.01	4.3-4.5	2.3
Redarmy	6.25±0.02	6.1-6.5	2.7	2.4±0.01	2.0-2.5	4.1	4.8±0.04	4.5-4.9	4.8	2.9±0.01	3.0-3.2	2.0	4.80±0.02	4.5-4.9	3.8
Neftegorsky	6.62±0.03	6.3-7.0	4.8	2.3±0.02	2.2-2,4	3.3	4.5±0.03	4.4-4.7	2.2	2.9±0.02	2.9-3.0	1.9	4.51±0.03	4.3-4.7	2.7
Pestravsky	6.55±0.04	6.3-6.9	4.5	2.2±0.04	2.1-2.3	2.1	4.4±0.02	4.4-4.5	1.6	3.0±0.01	2.9-3.1	2.0	4.44±0.02	4.3-4.6	3.2
Hvorostyansky	6.56±0.03	6.3-6.9	4.4	2.3±0.03	2.1-2.5	3.2	4.6±0.03	4.3-4,9	3.8	3.1±0.02	3.0-3.2	2.1	4.41±0.02	4.3-4.5	2.0
	Sign														
	Tarsal index, %			Length of the right front wing, mm			Width of the right front wing, mm			Qubital index, %			Discoidal displacement, %		
District	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	+	-	0
Alekseevsky	54.6±1.7	52.2-56.0	2.6	9.40±0.03	9.1-9.7	2.5	3.18±0.02	3.0-3.4	4.1	48.5±2.3	46.4-51.0	5.4	55.7	21.5	22.8
Bolsheglushitsky	54.6±1.4	50.1-58.7	4.8	9.33±0.02	9.0-9.6	2.2	3.22±0.02	3.0-3.4	4.4	51.2±2.2	45.1-58.0	11.7	49.8	13.0	37.2
Redarmy	54.5±1.6	52.0-56.4	2.7	9.31±0.02	9.1-9.6	2.5	3.26±0.02	3.0-3.3	2.2	61.3±1.9	54.3-65.0	12.8	25.1	59.4	15.5
Neftegorsky	55.7±1.9	51.2-59.2	3.6	9.20±0.02	9.0-9.4	1.9	3.10±0.02	3.0-3.2	1.9	46.7±1.9	45.0-48.2	2.9	58.8	10.2	31.0
Pestravsky	53.3±1.6	50.8-55.8	2.9	9.32±0.03	9.0-9.6	2.8	3.26±0.02	3.1-3.5	4.5	48.0±2.1	46.0-50.1	3.7	60.9	12.3	26.8
Hvorostyansky	55.6±1.5	53.0-57.0	3.2	9.37±0.03	9.0-9.8	3.1	3.30±0.02	3.0-3.5	4.8	49.6±2.2	46.0-54.0	6.9	41.9	24.1	34.0
Dry steppe zone															
	Sign														
District	Proboscis length, mm			Length of the 3rd tergite, mm			Width of the 3rd tergite, mm			Length of the 3rd sternite, mm			Width of the 3rd sternite, mm		
Bolshechnigovsky	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %
	6.32±0.15	6.0-6.4	4.4	2.31±0.01	2.0-2.6	4.6	4.6±0.01	4.4-4.6	2.0	2.7±0.01	3.0-3.1	1.9	4.77±0.01	4.4-4.6	2.0
	Sign														
	Tarsal index, %			Length of the right front wing, mm			Width of the right front wing, mm			Qubital index, %			Discoidal displacement, %		
	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	M±m	Lim	Cv, %	+	-	0
	56.2±0.7	53.0-57.0	3.7	9.28±0.02	9.0-9.6	2.2	3.2±0.02	3.0-3.4	4.8	64.7±1.2	54.5-61.0	5.5	24.5	71.0	4.5

The tested samples of workers and drones of the steppe zone also revealed the processes of hybridization of bee colonies: From six districts one Krasnoarmeisky contained bees that met the standard of the central Russian subspecies. At the same time, morphometric indicators of workers looked as follows, M ± m: Proboscis length, mm: (6.25±0.02); length of tergite 3, mm: (2.35±0.01); width of tergite 3, mm: (4.80±0.04); length of the 3rd sternite, mm: (2.9±0.01); width of the 3rd sternite, mm: (4.80±0.02); tarsal index,%: (54.5±1.6); length of the right front wing, mm: (9.31±0.02); width of the right front wing, mm: (3.26±0.02); cubital index,%: (61.3±1.9); negative discoidal displacement was revealed on average in 59.4% of individuals. Morphometric measurements of drones in the same district confirmed the ongoing processes of change in the population structure of bees in this district, M ± m: Cubital index, %: (62.1±1.4); negative discoidal displacement was revealed on average in 59.4% of individuals; the brown color of chitinous integuments was found in 38% of individuals. In the rest of the areas, the individuals to the least extent corresponded to the standard of the central Russian breed.

Evaluation of the taxonomic affiliation of *Apis mellifera* in the Bolshechernigovskiy region, the only one belonging to the dry steppe zone, revealed some changes in morphometric parameters, which also indicates the transformation of the population structure. The average length of the proboscis of bees was within the standard of the central Russian subspecies (6.0-6.4 mm) and amounted to 6.32±0.15 mm; along the length of the 3rd tergite (2.31±0.01) and the width of the 3rd sternite (4.77±0.01) mm, compliance with the standard was also observed, the width of the 3rd tergite (4.60±0.01) mm and the length of the 3rd sternite (2.7±0.01) mm was inferior to the standard. The tarsal index exceeded the standard (56.2±0.7). The length (9.28±0.02) mm and width (3.20±0.02) mm of the right front wing were following the standard. The cubital index (64.7±1.2) was also within the standard of the central Russian subspecies. Negative discoidal displacement prevailed over positive, neutral and was found on average in 71.0% of individuals (Table 2).

Average indices of morphometric measurements of drones by cubital index corresponded to the standard of the central Russian subspecies, M ± m, %: (62.6±1.1); however, negative discoidal displacement was found on average in 67.4% of the individuals and the brown color of the chitinous integument was found in 66% of bees.

Table 2: Results of morphometric measurements of *Apis mellifera* drones

District and locality			Sign: Qubital index M±m	Lim	Cv, %	Discoidal displacement +, %	-, %	0, %	Coloration of chitinous hairs on the abdomen *Black., %	*Cor., %	*Gray., %	*Yel., %
Forest steppe zone												
		1	2	3	4	5	6	7	8	9	10	11
Kamyshlinsky		Kamyshla	60.8±0.2	59.6-62.0	0.8	1.8	97.0	1.2	2.0	96.3	-	1.7
		Old ermakovo	63.1±0.1*	62.0-64.1	0,6	-	96.3	3.7	3.4	96.6	-	-
Volzhsky		Oak umet	63.4±0,3***	62.0-64.8	1.1	-	97.5	2.5	-	98.3	1.7	-
Koshkinsky		Orlovka	61.3±0.6**	58.3-64.2	0.9	-	98.6	1.4	1.3	95.7	1.0	2.0
Sergievsky	Kalinovka	Apiary N. 1	64.2±0.2***	63.3-65.0	0.7	-	98.0	2.0	1.8	95.7	2.5	-
		Apiary N. 2	62.4±0.5**	59.8-64.9	1.1	3.7	96.3	-	2.4	97.6	-	-
Syzransky		Usinskoe	61.0±0.3	58.6-63.4	0.9	1.2	97.2	1.6	1.8	98.2	-	-
Chelno Vershinsky		Shuttle-vertexes	63.7±0.6***	62.4-64.9	0.5	3.2	95.7	1.1	1.0	99.0	-	-
Transition (buffer) zone												
Kinel-Cherkassky		Kinel Cherkasy	63.7±0.2***	62.8-64.6	0.6	-	96.0	4.0	1.8	95.0	2.2	1.0
		Podgorny	62,6±0.6*	60,1-65,0	1.2	3.1	95.5	1.4	1.7	98.3	-	-
steppe zone												
Redarmy	Redarmy	Apiary N. 1	64.1±0.2***	63.1-65.0	0.9	1.2	96.3	2.5	1.0	99.0	-	-
		Apiary N. 2	62.2±0,3	59.7-64.6	1.3	1.0	95.8	3.2	2.0	96.2	-	1.8
Dry steppe zone												
Bolshechnigovsky	Bolshaya Chernihiv		62.5±0.3	60.2-64.8	0.9	1.0	96.7	2.3	1.4	98.6	-	-

Conclusion

Evaluation of the taxonomic affiliation of *Apis mellifera* in the Bolshechernigovskiy region, the only one belonging to the dry steppe zone, revealed some changes in morphometric parameters, which also indicates the transformation of the population structure. The average length of the proboscis of bees was within the standard of the central Russian subspecies (6.0-6.4 mm) and amounted to 6.32±0.15 mm; along the length of the 3rd tergite (2.31±0.01) and the width of the 3rd sternite (4.77±0.01) mm, compliance with the standard was also observed, the width of the 3rd tergite (4.60±0.01) mm and the length of the 3rd sternite (2.7±0.01) mm was inferior to the standard. The tarsal index exceeded the standard (56.2±0.7). The length (9.28±0.02) mm and width (3.20±0.02) mm of the right front wing were following the standard. The cubital index (64.7±1.2) was also within the standard of the central Russian subspecies. Negative discoidal displacement prevailed over positive, neutral and was found on average in 71.0% of individuals.

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Vladimir Grigoryevich Semenov: Preparation of the manuscript 15%.

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Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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