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Honey Production Potential and Cadastral Valuation of Melliferous Resources for the Southern Urals

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Abstract: Resource and cadastral valuation of natural melliferous resources in the Republic of Bashkortostan was conducted on the territory of 17 forest districts located in the mountain-forest zone of the republic. There were field trips to value tree (*Tilia cordata* Mill., *Acer platanoides* L., *Salicaceae*) and herbaceous biocenoses of melliferous plants being a source of main and supporting honey collection for bee families. The 297 sample plots of herbaceous biocenoses were analyzed. As the result it was found that the most important honey plants are 18 tree, 23 shrub and 221 herbaceous species with 94 of these melliferous plants being the main and a supporting source for honey collection. *Tilia cordata* Mill was found to be a predominant honey plant in the mountain-forest zone to provide up to 90% of the honey stock in some areas. Evaluating the proportion of Linden stands in the forest made it possible to distinguish between 3 areas: Linden share in the forest <10%, Linden share in the forest 10-30%, Linden proportion more than 30%. Forest districts located in the 3rd zone are found to be the largest sources of potential production of bee products. Cadastral valuation of melliferous resources in the mountain-forest zone provided the way to estimate the cost of potential production of bee products and to choose the highest number of bee families that can be kept in the mountain-forest zone. There is an opportunity for more efficient use of melliferous plants of the mountain-forest zone of Bashkortostan compared with the current level of beekeeping development.

Key words: Melliferous resources, *Tilia cordata* Mill, resource and cadastral valuation, nectar bearing capacity, honey bees, bee-keeping products, development

INTRODUCTION

It is necessary to know nectar and pollen bearing capacity of melliferous resources to maintain optimum load of bee colonies to get higher yields of bee-keeping products. This can result from well-arranged fixed apiaries or well-elaborated routes for non-fixed apiaries as well (Jitariu *et al*., 2014). To use melliferous resources available in rural areas efficiently the structure and share of melliferous plants in terms of the ratio between the number of melliferous plants and the potential amount of bee products are usually studied (Farkhutdinov *et al*., 2013a, b). The nectar sugar content as well as the pollen concentration per unit area are known to correlate with the number of corresponding plants. The amount of resources can be evaluated in regards to honey types as well as bee colony habitats (Hicks *et al*., 2016). Such monitoring provides better estimation of honey reserves primarily based on forest biocenosis (Decourtye *et al*., 2010).

Currently there is no common standard methodology to assess quality and availability of melliferous resources. Szigeti and others reviewed 158 research methods to study nectar bearing plants. Many of them are aimed to investigate abundance of flowering plants. They are found to have great methodological differences and not to provide a full assessment of food supply for beekeeping (Szigeti *et al*., 2016). Phytologic resource valuation focused on the analysis of common biocenoses does not provide a complete assessment of the resource base for beekeeping (Farkhutdinov *et al*., 2013a, b). One

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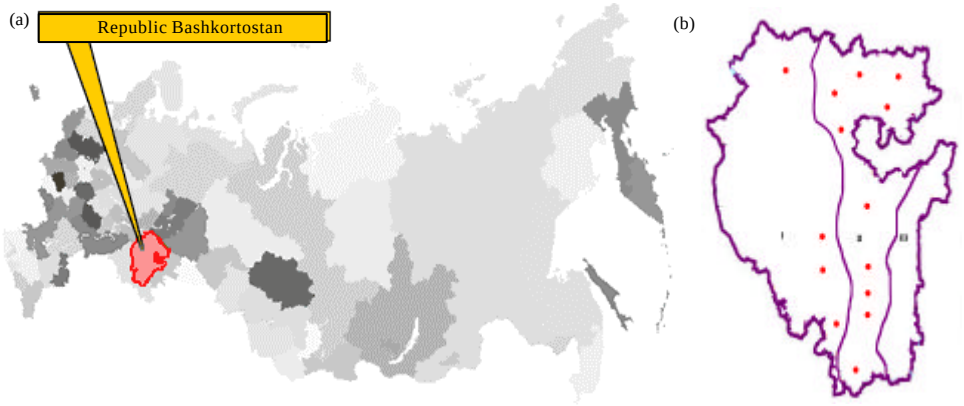

Fig. 1: Republic of Bashkortostan on the map of the Russian Federation; a) Zoning of the territory of the Republic of Bashkortostan and b) 1-forest-steppe zone; 2-mountain-forest zone; 3-steppe zone-location of the sample plots

of the new approaches to assess quality of melliferous sources is a joint phytologic and geographical, beekeeping and economic (cadastral) valuation of the territory (Varlamov *et al*., 2016).

The Republic of Bashkortostan is known for its unique natural resources and production of "Bashkir honey", being the national brand of the republic. Bashkir Linden honey takes the first place among the well-known floral honeys. However, its quality as well as organoleptic, physico-chemical, biochemical properties on the territory of the republic differ from Linden honey in other regions due to different composition of melliferous plants.

There are three natural zones (forest-steppe, steppe and mountain-forest) on the territory of the Republic of Bashkortostan. Each zone is characterized by a different spectrum of plant communities formed under the influence of certain agroclimatic factors having an impact on nectar bearing capacity of both wild and cultivated plants. The novelty of our approach lies in the combination of biological, zootechnical and economic evaluation of food supply for beekeeping. A phytologic assessment makes it possible to evaluate abundance of floristic composition of melliferous plants for a certain area. A beekeeping assessment helps to define the number of bee colonies that can be kept on the site, the potential output of gross and commercial honey and other bee products. An economic analysis is a cadastral valuation of melliferous resources that takes into account the climatic peculiarities of certain natural areas.

The urgency of the conducted studies is linked to the need for developed rational beekeeping in the region. Its aim is to preserve the unique burzyan population of dark forest bee *Apis mellifera* L. and full use of the melliferous resources of the mountain-forest zone. In this regard, the aim of our studies was a resource and cadastral estimation of melliferous resource in the mountain-forest areas as a basis to develop scientific bases for their rational use.

Previously, we carried out a comprehensive comparative study of the natural melliferous resources located on the territory of the Bugulma-Belebey upland in the Republic of Bashkortostan (RB) (Khisamov *et al*., 2014a, b). This territory lies in the forest-steppe zone. There are phytologic-geographical differences in biocenoses composition of forest-steppe and mountain-forest zones. The mechanistic extrapolation of the received data on honey reserve assessment for the mountain-forest zone seems to be incorrect.

The research place: The mountain-forest zone covers 2.1 million ha or 15% of the Bashkortostan Republic's area. There have been no studies of this type conducted in the region (Fig. 1).

MATERIALS AND METHODS

In the course of the conducted field research resource and cadastral valuation of melliferous sources in the most typical territories of the mountain-forest zone of the republic was performed. Recording melliferous resources was carried out in several stages: inventory of the species composition of nectar bearing plants, identifying species diversity of melliferous plants in a certain area, nectar bearing capacity and its availability to honeybees and conducting an economic assessment of potential bee products for the the studied region. The following provisions were offered as the basis for cadastral registration of melliferous plants Farkhutdinov *et al*., 2013a, b).

The species is a nectar and (or) pollen plant in the studied region, a wild-growing species is common in the region; the presence of natural pollinators with their natural activity during plant flowering from early Spring to late Autumn, foraging behavior of honey bees when collecting nectar, pollen and propolis, accounting

natural-growing plants that can be toxic to bees and result in their poisoning, description of the flowering phase of of melliferous plants and required pollination parameters (flowering beginning, end and duration, flower pollination frequency, the optimal number of pollinators per unit area or the flowering period, the number of bee colonies per 1 ha, etc.). Thus, we carried out a range of activities, including:

- Investigating species composition of melliferous plants growing under different phytocenoses
- Evaluating flowering timing, duration and sequence of melliferous plants (honey production line)
- Analysing life form spectrum of melliferous plants

The number of honey plants and the area they occupy in forests and grasslands were determined by the route survey routes were laid by quarters. Then lands were investigated (Farkhutdinov *et al*., 2013a, b; Khisamov *et al*., 2014a, b).

Assessment of forests was conducted by the pre-planned route. On the process all the trees growing in a 2 m strip (1 m to the right and 1 m to the left) were counted (by species). On the way back the shrubs were calculated. Then the ratio (%) of nectar bearing species of trees and shrubs as well as the area they occupy was found. Defining the area of honey plants in the studied strip provides a way to estimate the nectar bearing capacity of the area covered by melliferous tree species (Farkhutdinov *et al*., 2013a, b).

Nectar bearing capacity evaluation for meadows, pastures, bogs and unsuitable lands was conducted by counting the number of stems per 1 m^2 of melliferous plants. The studied plots were examined arriswise. Measuring 100-200 steps on the ground the 1×1 m sized square was determined to find the number of nectar bearing plants in the grass. Then the entire amount of the plants was taken as 100% and the percentage of each species in the square was calculated. Then according to the ratio of plants in the grass stand the total area of the particular nectar bearing plant for the given plot was accounted (Farkhutdinov *et al*., 2013a, b).

Based on the reference data the total potential amount of nectar secreted by each honey plant for each land separately is calculated. Then the resulting figures were summed up (Al-Ghamdi *et al*., 2016; Bagella *et al*., 2013).

In mixed forest biocenosis honey plants grow mostly unevenly. Thus direct accounting of plant number per unit area is not suitable. To find the number of some plant species in the territory of 1 ha a projective cover in percent for square was used. It was done separately for each type of the studied honey plants that was transferred to full grass stands (Farkhutdinov *et al*., 2013a, b). To calculate Linden nectar bearing capacity in composition of different crops we used the formula:

$$M = N \times 0.1\ K \times C \times S$$

Where:

M = Linden nectar bearing capacity
N = Reference nectar bearing capacity per 1 ha (Szigeti *et al*., 2016)
K = Linden coefficient in crop composition; Linden flowering length, days (assumed to be 14 days)
S = The area of the allotment

When determining the total available nectar reserve we take into account that bees collect not more than 30% of nectar.

The received experiment results were determined by methods of variation statistics using Software Statistics 6.0. The difference reliability was determined using the student's criterion.

RESULTS AND DISCUSSION

Assessment of melliferous resources in the territories of the Burzyan, Gafuri, Kugarchi, Kananikolskoye, Makarov forestry districts showed that forest areas are characterized as: goutweed Linden groves and oak forests, short-footed reedgrass Linden groves and oak forests, short-footed reedgrass pine forests with common and steppe meadows in their composition.

We carried out a taxonomic description of *Tilia cordata* Mill. in all the areas of forest districts that were found on the route of the field work. The conducted valuation of Linden resources in the mountain-forest zone and adjacent territories of Bashkortostan Republic made it possible to divide the forest districts into 3 groups. Group 1 included forest lands characterized by small number of *Tilia cordata* (<10% of the total forest area). Table 1 demonstrates that group 1 forests are located in Northern and Southern forest districts (Yanaul and Kananikolskoye). The main dominant species are coniferous trees.

There are mostly pine and birch species on the territories of Avzyan and Burzyan forest districts. Although, there are protected areas where ripe and overripe Linden forests can be found. They provide main production of wild honey (Ishemgulov *et al*., 2013).

Group 2 include forests with 10-30% of *Tilia cordata* Mill. The analysis of species composition in Sterlitamak

Table 1: Distribution of *Tilia cordata* areas in the mountain-forest zone and adjacent territories according to age groups

		Linden stands in forest vegetation (ha)						
				Young growth				
Forest districts	Total forests, thousand (ha)	Total (ha)	Percentage of the forest fund	1 age class	2 age class	Middle-aged	Ripening	Ripe and overripe
Yanaul	160.3	9320	5.8	929	614	7200	564	13
Belokatay	210.4	33871	16.0	3435	1004	5992	6352	17088
Karaidel	235.0	33391	14.2	3279	4004	18431	3576	4101
Nurimanovo	210.8	41470	19.6	1266	6854	28884	4037	429
Birsk	148.6	34887	23.5	8142	753	19850	3779	2363
Iglino	125.3	47803	38.2	378	738	13281	11078	22328
Arkhangelsk	207.8	72792	35.0	1696	4802	16073	7909	42312
Sterlitamak	187.3	21240	11.3	907	906	18359	823	245
Gafuri	210.1	91160	43.4	1653	2935	36808	9076	40688
Avzyan	269.9	25161	9.3	205	148	1740	1951	21117
Inzer	256.2	58340	22.8	4295	2471	10273	3061	38240
Makarovo	289.3	96409	33.3	1945	2357	25463	7501	59143
Burzyan	320.8	24587	7.6	51	122	2049	804	21564
National park "Bashkiria"	76.5	43194	56.5	28	224	19180	15334	8428
Kugarchin	167.4	46342	27.7	639	985	8171	5733	30814
Zianchura	127.8	32794	25.6	1325	820	7907	4700	18042
Kananikolskoye	211.2	4346	2.1	97	36	398	47	3768
Total (ha)	3414.7	717107	23.0	30270	29773	240059	86325	330683

forest district showed the forest-steppe impact reflected in the vast growth of hardwood, especially, *Quercus robur* L. There are mostly middle-aged Linden stands on the territory of group 2. The number of ripe stands of *Tilia cordata* is not very big.

Karaidel forest district is partially located in the zone of dark coniferous forests and the right bank of the Ufa River is covered with a large number of *Tilia cordata* Mill. There are mainly middle-aged Linden forests.

Belokatay forest district is an area of mixed forests with a great variety of coniferous and broadleaved species. In forest lands of the given district a lot of ripe and overripe *Tilia cordata* trees grow.

There are mainly soft-wooded tree species in Nurimanovo forest district. Certain parts have dominant Linden plantings. Many residents consider this district to be a traditional place to produce honey and one of the major "Beekeeping" regions of Bashkortostan Republic. There are many middle-aged Lindens, though few ripe and overripe Linden stands being the main suppliers of nectar. Inzer forest district has a very heterogeneous structure in terms of the species composition. It is due to climatic peculiarities of the area. Under favorable weather conditions there is always high honey yield from ripe and overripe trees *Tilia cordata*.

Geographically the Birsk forestry is mainly located in the forest-steppe zone and only part of its lands belongs to the mountain forest zone. *Tilia cordata* Mill is the main forest-forming species in the forestry. There are many middle-aged stands of *Tilia cordata*. Their combination with meadow vegetation is a reliable forage base for beekeeping development.

The Zianchura forestry is far to the South. It's the trans-Uralian climatic zone. The Northern part of the forestry is located on the South-Western slopes of the Southern Urals and belongs to the mountain-forest zone. This climatic zone is favorable for growing of *Tilia cordata* Mill. There is a good age structure of Linden forests. However, this area is often exposed to Southern dry hot winds that reduce nectar bearing capacity of *Tilia cordata*.

The territory of the Kugarchy forestry is located in the mixed forest zone. There are mostly broad-leaved species (*Betula pendula* Roth., *Tilia cordata* Mill., *Quercus robur* L., etc.). In the forests of the area, there is the largest share of mature and over-mature *Tilia cordata* making 66.5% of the total area of Linden stands among all the studied forest enterprises.

Group 3 includes forestries where the share of Linden stands exceeds 30% of the total forest area. The Makarovo forestry is situated in the Cis-Uralian climatic zone. In its forests *Tilia cordata* Mill., *Betula pendula* Roth., *Populus tremula* L., *Acer platanoides* L. and *Quercus robur* L. dominate. Here is the largest area of mature and overmature stands of *Tilia cordata* in the republic.

The territory of the Arkhangelsk forestry favors the growth and development of soft-wooded broadleaved and coniferous species. This is a district with well developed beekeeping. More than 50% of *Tilia cordata* Mill. belong to the mature and overmature age groups. This area is widely used by beekeepers to relocate apiaries from other parts of the republic.

The greates part of the Iglino forestry is covered by broadleaved forests (*Tilia cordata* Mill., *Acer platanoides* L., elm, *Quercus robur* L.). About 50% of *Tilia cordata* Mill. belong to the mature and overmature age groups. When weather conditions are favorable for nectar excretion these stands provide abundant honey collection in the area.

The forest fund in Gafuri district consists mainly of Linden and maple stands that is extremely important for beekeeping development. There is the highest nectar bearing capacity of *Tilia cordata* in the republic (Ishemgulov *et al*., 2013).

The share of *Tilia cordata* Mill in in the national Park "Bashkiria" is the largest in the total forest fund of the republic being mainly presented by middle-aged and ripening stands. This area is favorable for beekeeping development, especially in the form of wild hive beekeping.

We found that 717107 ha of the mountain-forest zone in Bashkortostan are covered by Linden stands with 330683 ha of ripe and overripe age groups or 46% of trees secreting nectar actively. A single tree *Tilia cordata* Mill. at the age of 80-120 years is known to secrete up to 1.5 kg of nectar for 12 flowering days (Farkhutdinov *et al*., 2013a, b). Evaluating the data on honey collection on the territory of the mountain-forest zone showed that different-aged standings of *Tilia cordata* Mill. are characterized by different nectar bearing capacity (Ishemgulov *et al*., 2013).

Nectar bearing capacity assessment of young growth of I and II age classes proved that they could potentially excrete about 28055139 kg of nectar on the territory of 60043 ha that is in terms of collected honey is 17534462 kg. Middle-aged Linden forests can provide up to 122401272 kg of nectar or 76500795 kg of honey on the territory of 240059 ha. A group of ripening Linden forests can potentially excrete 62412972 kg of nectar or 39008107 kg of honey on the area of 86325 ha. Finally, the group of ripe and overripe Linden forests cover the territory of 330683 ha. They can potentially produce 266861172 kg of nectar or 166788232 kg of honey. Summing up the potential nectar bearing capacity of Linden stands in the mountain-forest zone we can get 299831596 kg of honey. Taking into account availability for bee colonies being about 30% (Farkhutdinov *et al*., 2013a, b) it makes 99943865,5 kg of Linden honey.

Many researchers when evaluate honey collection capacity of the forest zone usually assess only honey reserves of *Tilia cordata* Mill. (Ishemgulov and Burmistrov, 2008; Ishemgulov *et al*., 2013). In our opinion it is exact. For instance in 2010, 2012, 2017 Linden stands in the mountain-forest zone excreted nectar very unevenly and in small amounts. Especially in the Southern part of the mountain-forest zone from the Zianchura to the Burzyan forestries nectar secretion from *Tilia cordata* Mill. was insignificant. However, forage and commodity honey was collected due to nectar of grassland communities. In the same years nectar secretion by *Tilia cordata* Mill. practically corresponded to the average yearly values in more Northern districts (Birsk and Nurimanovo forestry).

In our opinion, it is important to assess melliferous resources of other important nectar excreting plants in particular *Acer platanoides* L., *Salix* L. and grass communities (Table 2).

Acer platanoides L and osier available in the forests is of great value as the nectar excreted by them has a positive effect on the rapid development of bee colonies in Spring. As you can see in Table 2, there are many stands of *Acer platanoides* L. in the Makarov and the Archangel forestries. The Gafuri, the Zianchura and the Makarov forestries are well presented by various species of *Salix* L. (there are 25 species of *Salix* L. in the republic of Bashkortostan).

The area of *Acer platanoides* L. is 60469 ha in the mountain-forest zone (Table 2). Nectar bearing capacity of *Acer platanoides* L. is up to 150 kg/ha or 50 kg/ha in terms of 30% availability. Thus, nectar bearing capacity of *Acer platanoides* L. in the mountain-forest zone is potentially 3023450 kg of nectar or 1889656 kg of honey.

According to the reference data melliferous capacity of different species of *Salicaceae* is an average of 150 kg/ha or 50 kg/ha in terms of 30% availability . The total area of *Salix* L. in the mountain-forest zone is 6846 ha. Thus, nectar bearing capacity of *Salix* L. is: 342300 kg of nectar, 213937 kg of honey.

As our field studies showed nectar bearing capacity of clearings, open forests, cuttings and burnt areas, consists mainly of the following representatives: *Chamerion angustifolium* (L.) Holub, *Rubus idaeus* L. *Archangelica officinalis* Hoffm., *podagraria* L., *Solidago virgaurea* L., *Geranium sylvaticum* L., *Heracleum sibiricum* L., *Pulmonaria obscura* Dumort., *Angelica sylvestris* L. and others. Mostly all honey plants that can be found on the natural edges grow on the given forest areas. But their proportion is higher in terms of number and nectar bearing capacity. As a rule, honey plants begin to appear at the 2nd year after cuttings and dominate for the next 5-6 years. Then they are gradually substituted by young forest. Honey vegetation on burnt areas is preserved much longer than there after cutting. The highest spread of *Chamerion angustifolium* (L.) Holub and *Rubus idaeus* L. in the mountain-forest zone is usually observed for burnt areas or those where cutting is performed every 3 or 6 years. Though high nectar bearing capacity remains within 3-6 years. Highly productive honey plants *Origanum vulgare* L.,

Table 2: Areas covered by *Acer platanoides* L., *Salix* L. and herbaceous plants of different associations

Forest districts	All the forests, thousand (ha)	Forest vegetation and plantings (ha)						
		Acer	Salix	Clearings wastelands	Cutting+burnt areas	Light forests	Glades+Hay fields	Pastures
Yanaul	160.3	159	21	83	1051+25	21	2013	2491
Belokatay	210.4	110	12	533	1104+12	33	21719	26610
Karaidel'	235.0	53	70	110	90+0	317	7947	2262
Nurimanovo	210.8	5043	29	312	1133+1	195	1317	128
Birsk	148.6	80	84	123	863+12	39	4665	466
Iglino	125.3	787	390	392	289+29	75	1645	835
Arkhangelsk	207.8	16388	448	120	284+47	12	2252	2181
Sterlitamak	187.3	154	58	203	480+83	502	3589	3781
Gafuri	210.1	3034	1914	96	98+83	19	3696	1688
Avzyan	269.9	0.61	309	119	996+0	248	9170	9112
Inzer	256.2	32.7	0.51	36	517+0	23	7206	1991
Makarovo	289.3	28838	1235	147	413+34	49	5190	6099
Burzyan	320.8	3860	-	2881	5277+172	200	6491	7973
Kugarchin	167.4	1480	454	89	52+0	129	3459	10084
Zianchura	127.8	400	1755	219	63+1	-	2799	931
Kananikolskoye	211.2	50	67	806	3092+1	213	5765	19870
Total	3338.2	60469	6846	6269	15802+499	2075	88923	96502

Phlomoides tuberosa (L.) Moench, *Thymus serpyllum* L., *Serratula coronata* L., *Medicago falcata* L., *Vicia cracca* L., *Trifolium pratense* L., *Echium vulgare* L. can be met on the territory of foothill steppe areas.

The total area of damaged plots was 24646 ha. The estimated nectar bearing capacity of honey plants growing on this territory ranged from 50 kg/ha to 350 kg/ha. After statistical processing of the data from the trial areas we got the figure of 120 kg/ha. Thus, melliferous potential of these areas is as follows: 985840 kg of nectar or 616150 kg of honey (Table 2).

Melliferous resources of glades, hay fields and pastures (185424 ha) were calculated by multiplying the area of the studied lands (ha) to their mean value of nectar bearing capacity. When describing the trial sites 94 melliferous plants being used by bees mainly as their supporting nectar supply for honey collection were found. Some honey plants form different communities and their nectar bearing capacity varies. When determining nectar bearing capacity of glades, the data ranged from 4.5 kg/ha (with the higher share of *Fragaria vesca* L., *Achillea millefolium* L. and *Origanum vulgare* L. in the biocenosis) to 150 kg/ha in communities with the dominant share of *Chamaenerion angustifolium* (L.) Scop. High nectar bearing capacity being 70±15 kg/ha in average was found for flood sample plots with dominating *Heracleum sibiricum* L., *Angelica sylvestris* L., *Aegopodium podagraria* L. The average nectar bearing capacity of mountain slopes was found to be 25-30 kg/ha. They provide Spring honey harvest necessary for bee development. The main producers of Spring nectar are *Salvia verticillata* L., *Echinops sphaerocephalus* L. and different bulbous plants.

To find the mean value on nectar bearing capacity was quite difficult due to the diverse species composition of glades in the Northern, central and Southern parts of the mountain-forest zone. Glades in the Makarov forestry located in the centre of the mountain-forest zone had the highest nectar bearing capacity. The Northern and Southern districts were less productive. For example, the share of graminaceous species on the glades of the Southern Zianchura forestry is rather high. There is the influence of the steppe phytocenosis. There are few honey plants on the glades of the Northern Belokatay forestry. Climatic conditions in the district are not favorable for nectar excretion. When averaging we got the value of 50 kg/ha. However, to determine nectar bearing capacity for the mountain-forest zone we used the data received on sample plots of the studied forestries. So we found that nectar bearing capacity of glades on the territory of 185424 ha is 3090400 or 1931500 kg of honey (Table 3).

Table 3: Estimated honey reserves in the mountain-forest zone of Bashkortostan Republic

Melliferous resources	The number of honey reserves (kg)	The share in honey reserves (%)
Tilia cordata Mill	99943865	95.55
Acer platanoides L	1889656	1.83
Salicaceae	213937	0.20
Grasslands of the damaged areas (clearings, light forests, cuttings and burnt areas)	616150	0.58
Natural grasslands (glades, hay fields and pastures)	1931500	1.84
Total	104595108	100

Assessment of melliferous resources in mountain-forest zone of the Republic of Bashkortostan proved the cited evidence that the dominant nectar bearing species is *Tilia cordata* Mill (95.55% share in honey reserve). Within the studied area, *Tilia cordata* Mill. is located very unevenly (Table 1 and 3). The main forest standins of *Tilia cordata* Mill. are in the Makarov, Gafuri, Iglino, Archangel, Inzer, Kugarchin and

Nurimanovo forestries. These forest are essential for production of valuable Linden honey. When weather conditions are favorable for nectar excretion of *Tilia cordata* Mill. it is necessary to arrange mobile apiculture in these forestries. Although, the share of nectar reserves of *Acer platanoides* L., *Salix* L. and the herbaceous communities is relatively small and accounts only 4.45 %. However, there are available alternative sources of nectar that makes it possible to preserve the population of stationary bee colonies in unfavorable for beekeeping years.

Thus, the estimated total honey supply on the territory of the mountain-forest zone of the Republic of Bashkortostan is 70609626 kg. It is known that the annual demand of a bee colony for honey is an average of 95 kg.. The average yearly honey output is 25 kg. Thus, one bee colony needs 120 kg of honey, respectively (Ishemgulov and Burmistrov, 2008a, b; Farkhutdinov *et al*., 2013a, b). Based on these data the maximum number of hives that can be kept in the mountain-forest zone is calculated according to the honey supply formula: 120 kg = 70609626:120 = 588413 bee colonies. To meet the annual needs of bee colonies it is necessary to get 55899235 kg of honey. Production of commercial honey can be 14710391 kg of Linden honey (Farkhutdinov *et al*., 2013a, b).

Besides honey production, it is necessary to estimate output of beeswax, propolis, pollen load and bee bread. The world experience for many years shows that it is often unprofitable to get only honey. Even if one bee colony produces 2 kg of pollen load, 1 kg of bee bread, 100 g of propolis and 1 kg of beeswax, the potential production of Biologically Active Bee Products (BABP) will bring considerable profit (Farkhutdinov *et al*., 2013a, b; Ishemgulov and Burmistrov, 2008). According to our calculations 70609626 kg of honey (including 2000 kg of wild honey), 1176826 kg of pollen load, 588413 kg of bee bread, 588413 kg of propolis and 588413 kg of beeswax can be produced. Receiving relatively small amount of expensive wild honey produced in the mountain-forest zone cannot exceed 2000 kg. This is due to the small number of beekeepers engaged in this type of apiary and relatively small output of honey compared to of bee colonies. It should be noted that received production output of beekeeping products are lowest.

An important part of the work is the cadastral evaluation of all bee products that can be collected in the mountain-forest zone of the Republic of Bashkortostan (Table 4).

Table 4: Potential production of beekeeping products and its estimated cost (thousand million rub., million USD)

Beekeeping products	Total output (kg)	Price per kg, rub.,/USD	million rub/mln (USD)
Linden honey	14708391	200/3.33	2941.7/49.0
Wild honey	2000	900/15	1.800/0.03
Pollen load	1176826	600/10	706.1/11.8
Bea bread	588413	1200/20	706.1/11.8
Propolis	58841.3	2000/33.3	117.7/1.96
Beeswax	588413	290/4.8	170.6/2.8
Total	-	-	4643.9/77.4

As one can see from Table 4 the average market price of bee products to be potentially produced is more than 77 million dollars. Honey production makes over 60% of them.

Scientific novelty of the received data in the course of diverse studies of the mountain-forest zone is that variation of morphobiological characteristics of melliferous plants was investigated. Secondly, it is obvious that developing an inventory of melliferous resources is related to many-faceted database including information on species composition of melliferous plants, their nectar, pollen and propolis output in different phytological and geographical conditions, the number of received beekeeping products, the market value of bee products, etc. Farkhutdinov *et al*. (2013a, b), Teichroew *et al*. (2017) and Varlamov *et al*. (2016). The main approaches to the development of the database structure on melliferous plants and their record in the cadastre of melliferous resources are under further development.

CONCLUSION

In conducting the comprehensive study of natural melliferous resources of the mountain-forest zone on the territory of Bashkortostan Republic we have found that honey production potential of the zone makes it possible to keep more than 550 thousand bee colonies. It is obvious that currently the economy of the republic does not use the renewable melliferous resource areas in full. They can yield more than $77 million dollars from sales of bee products. One of the reasons is that Linden stands predominate in honey harvest. They excrete nectar unstably and short-termly. Thus, mobile apiculture is the most profitable way of beekeeping in the region. Potential production output and sales of high-quality bee products makes it possible to recommend to develop plots for mobile apiary. They should be far from stationary apiaries on the one hand and situated in areas with a large proportion of mature and overmature trees of *Tilia cordata* in the forest. Such resource and cadastral valuation will be required on a quarterly

evaluation of melliferous resources of separate forestries. Subsequently, the conducted comprehensive analysis will allow to carry out actions on preservation and renewal of Linden stands.

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