

Melliferous resources in Charyshsky district (Altai Krai)

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The present paper provides results and analysis of floristic composition and vegetation resources of Charyshsky district, Altai Krai. Crop production in Altai Krai is of primary importance for apiculture. Melliferous resources of cultivated plants as well as of native plants are displayed in the paper. Vegetation resources are sorted out into groups, number of species in each group is counted. We conducted melissopalynological studies of honey samples from Charyshsky district and identified taxonomic diversity of pollen spectrum of natural honey samples, and their compliance with the basic melliferous plants. In the melliferous base of Charyshsky district locality there were identified 185 species of mellifers (19, 6% of total species number). Model plots of Charyshsky district refer to mountain-forest zone and have the most stable honey harvest, due to a wide range of plants species. Melissopalynology studies showed that honey samples of Charyshsky district are polyfloral. The pollen composition of honey reflects the type of vegetation in the area. Analysis of honey samples collected from Charyshsky district model plots located in the mountain forest zone (Altai Krai) revealed that the pollen of the families Apiaceae, Asteraceae, Brassicaceae, Fabaceae, Ranunculaceae, Rosaceae is prevailing, while on the model plots of the third type found in field agrocoenoses the pollen of the family Polygonaceae is predominating. Midlands and lowlands with fir-aspen forests with tall herbaceous plants (black taiga) have high melliferous potential. Melliferous resources along with other types of vegetation resources are being destroyed as a result of human economic activity (arable land, grazing, forestry activities) therefore it is necessary to provide environmental resource management and resource efficiency approach.

Key words: Vegetation resources; Melissopalynology; Pollen; Melliferous plants

Introduction

Flora of Altai Krai demonstrates a wide range of species diversity. Charyshsky district located in the south of Altai Krai is quite different from other territories of the region. Its territory fully belongs to the Altai Mountains. The vegetation of the district mainly represents various steppe, meadows and forest formations located in high-altitude zone from mid-latitudes to high-latitudes. Melliferous base of Charyshsky district in Altai Krai is characterized by natural vegetation native to an area and agricultural crops agrocoenoses. Crop production in Altai Krai is of primary importance for honey yield. Among the most important melliferous arable crops are buckwheat, sunflower, sinapis, oilseed rape, onobrychis, white and yellow sweet clover; main pollinator attractive vegetable and cucurbit crops are cucumber, pumpkin, watermelon, melon. Collecting nectar and pollen by honeybees in agricultural crops is essential for monofloral and polyfloral honey production.

Methods

Object of study is melliferous flora of Charyshsky district, characterized by plant species diversity. The research took place during 2015-2017. Floristic survey was carried out through field and lab research. Laboratory findings of the present melissopalynological study were made in accordance with national and international standards (Interstate standard GOST 31769-2012 «Honey. Determination of the frequency of pollen grains occurrence», National German standard DIN 10760:2002 «Analysis of honey — Determination of the relative frequency of pollen», NEQ).

Results

Floristic field surveys allowed us to collect herbarium specimens and honey samples from different districts of Altai Krai. In a series of field studies, model plots were selected with the applied methodology of field geobotanical surveys, in-depth analysis and using the forthcoming extrapolation method of the identified characteristics to less studied natural territorial complexes. Selected methodological approach to describing vegetation model plots was designed to determine the floristic composition of honey plants from the localities under study. Methodology for botanical-palynological research is fully developed and presents the data for model plots of the mountain forest zone (Charyshsky district) with a description of flora and vegetation of the given territory and its type of vegetation (steppe, meadow, subalpine and alpine meadow, forest). A total of 940 species of vascular plants that belong to 353 genera of 93 families have been identified in the district and the largest families are listed in Table 1 (Flora... 2003):

Table 1. Largest families of the Charyshsky district flora.

Family	Number of species	% of total species number
Asteraceae	131	13.9
Poaceae	83	8.8
Cyperaceae	59	6.2
Fabaceae	49	5.2

Lamiaceae	43	4.5
Apiaceae	40	4.2
Rosaceae	40	4.2
Ranunculaceae	39	4.1
Scrophulariaceae	39	4.1
Caryophyllaceae	28	2.9
Total	551	58.1

We made vegetation resources inventory, and sorted out 12 groups with an emphasis on melliferous flora quantitative registration (Table 2) (Flora...2003). In the melliferous base of Charyshsky district locality there were identified 185 species of mellifers (19, 6% of total species number). Dominant mellifers are Apiaceae, Asteraceae, Brassicaceae, Fabaceae, Lamiaceae, Ranunculaceae, and Rosaceae (Flora... 2003).

Table 2. Groups of vegetation resources in the Charyshsky district flora

№	Vegetation resources	Number of species	% of total species number
1	Medicinal	320	34
2	Ornamental	287	30.5
3	Forages	258	27.4
4	Melliferous	185	19.6
5	Edible	101	10.7
6	Industrial (non-food)	79	8.4
7	Poisonous	62	6.5
8	Natural dye	18	1.9
9	Vitamin	14	1.4
10	Oilseed	10	1
11	Tanniferous	9	0.9
12	Fines herbes	6	0.6

Analysis of honey samples collected from Charyshsky district model plots located in the mountain forest zone (Altai Krai) revealed that the pollen of the families Apiaceae, Asteraceae, Brassicaceae, Fabaceae, Ranunculaceae, Rosaceae is prevailing, while on the model plots of the third type found in field agrocoenoses the pollen of the family Polygonaceae is predominating (*Fagopyrum sp.*) (Table 3).

Table 3. Pollen occurrence in honey samples by families in the Charyshsky district model plots

Taxon	Natural zone		Mountain forest zone			
	Model plot 1		Model plot 2		Model plot 3	
	NP	FO,%	NP	FO,%	NP	FO,%
Apiaceae	890	76.86	910	76.54	740	59.92
Asteraceae	120	10.36	43	3.62	60	4.86
Brassicaceae	80	6.91	122	10.26	148	11.98
Fabaceae	-	-	40	3.36	102	8.26
Lamiaceae	-	-	34	2.86	-	-
Liliaceae	-	-	4	0.34	-	-
*Pinaceae	-	-	-	-	2	0.16
Fagopyrum (Polygonaceae)	-	-	1	0.08	20	1.62
Ranunculaceae	-	-	6	0.5	-	-
Rosaceae	68	5.87	29	2.44	90	7.29
Tiliaceae	-	-	-	-	1	0.08
Valerianaceae	-	-	-	-	72	5.83
Total:	1158	100	1189	100	1235	100

Note: NP - total number of pollen grains recorded; FO - frequency of occurrence, * - pollen of coniferous plants.

Thus, Charyshsky district belongs to the mountain forest zone and is considered as one of the most favorable sites for honey yield and production due to plant species diversity (Nenasheva, 2017).

Laboratory findings of the present melissopalynological study testify that only a few plant species are major nectar and pollen sources despite the large variety of flowering plants in the studied locality. It also demonstrates that honey of mountain forest zone is polyfloral. Peculiarity of polyfloral honey pollen spectra in Altai is the occurrence of 10-12 family members pollen in very high percentiles despite the leading taxon prevalence. Honey has a distinct flavor and takes on flavor characteristics of the local flower's scent. Considering mountain altitudinal belt landscape differentiation according to V.A. Nikolayev (1986) and applying landscape basis (Landscape... 2016), Figure 1 shows percentage correlation of melliferous resources in Charyshsky district locality.

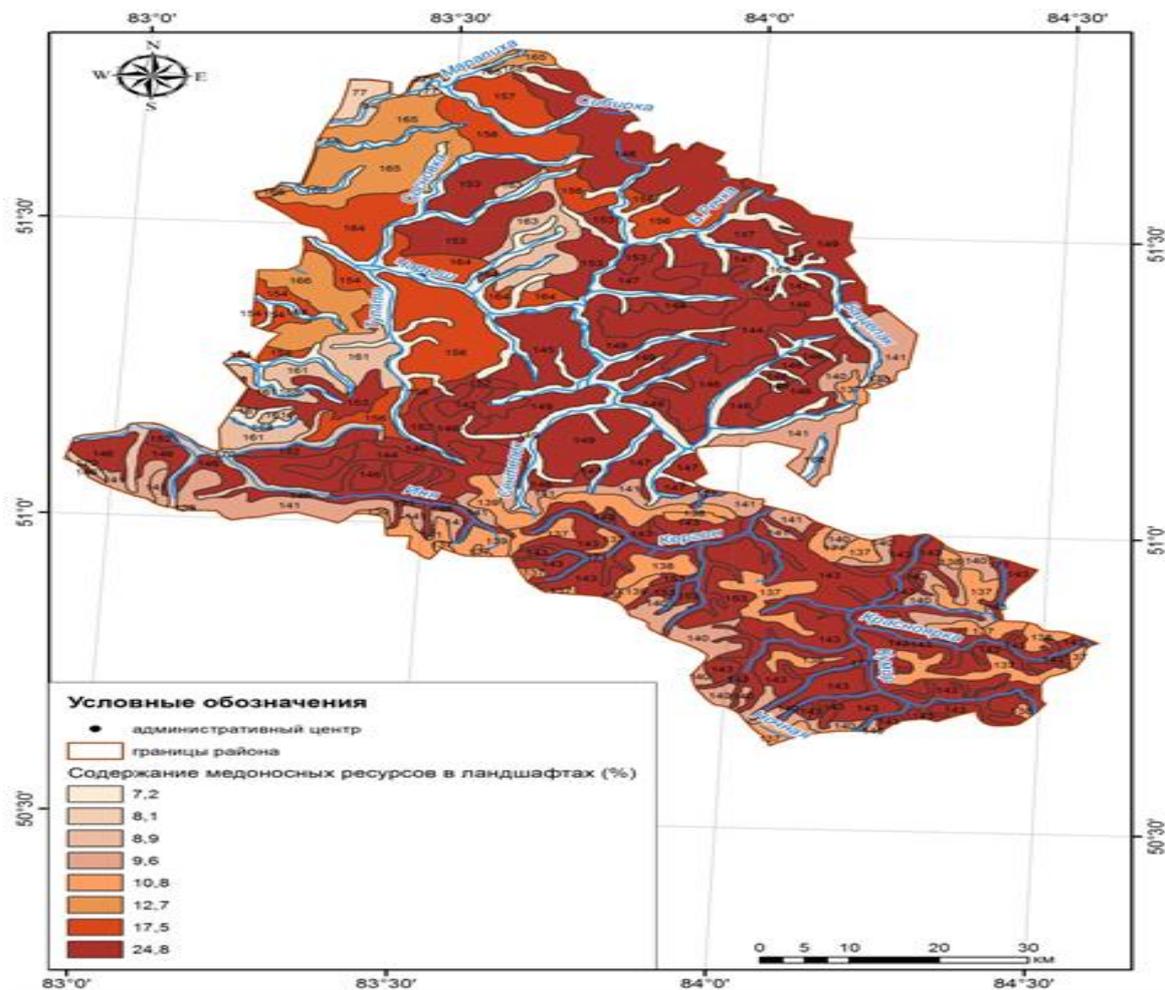


Figure 1. Number of melliferous resources in Charyshsky district locality.

Pre-mountain plains with herbs – grain – feather grass meadow steppes in leached chernozem demonstrate the smallest number of melliferous resources (7, 2%). Its distinct family members are Lamiaceae, Fabaceae, Apiaceae (*Salvia dumetorum* Andr. ex Besser, *Lamium album* L., *Melilotus albus* Medik., *Lathyrus pratensis* L., *Aegopodium podagraria* L.). Steep and rugged terrain with meadow shrubs and rocky steppes in chernozem meadow soils also reveals reduced melliferous flora (8.1-8.9%). Its distinct family members are Salicaceae, Caryophyllaceae, Polygonaceae (*Salix alba* L., *Dianthus versicolor* Fisch. ex Link, *Stellaria graminea* L., *Fagopyrum tataricum* (L.) Gaertn.).

A slightly larger number of honey plants (9.6 - 10.8%) is characteristic for convex hillslopes and watershed terrain with alpine and alpine-subalpine short grass meadows in mountain-meadow, soddy-podzolic soils (*Aquilegia sibirica* Lam., *Trollius altaicus* C. A. Mey., *Corydalis pauciflora* (Stefh. ex Willd.) Pers., *Galium boreale* L., *Chenopodium album* L.). Low-mountain hilly terrain with meadow forest steppes in mountain leached chernozem accounts for 12.7% of honey resources (*Onosma simplicissima* L., *Angelica tenuifolia* (Pall. ex Spreng.) Pimenov, *Potentilla bifurca* L., *Filipendula ulmaria* (L.) Maxim.).

Midlands and lowlands with fir–aspen forests with tall herbaceous plants (black taiga) on mountain-forest soddy podzolic soils have high melliferous potential with an index of 17.5 to 24.8% (*Centaurea sibirica* L., *Tussilago farfara* L., *Viola altaica* Ker Gawl., *Trifolium lupinaster* L., *Angelica sylvestris* L., *Fragaria vesca* L.).

Study of melliferous plants is of the greatest significance for the effective territory management regarding melliferous resources of cultivated and native plants. Natural landscapes of Charyshsky district are characterized by a low and moderate degree of change, mainly related to grazing and forest management. Tilled soils occupy no more than 25% of the locality, extensively used agricultural soils with vast natural landscapes take up to 50% of the locality, landscapes with a high degree of change account for 15% of the total area.

In the gross output of agriculture the share of livestock farming in Charyshsky district accounts for 76%, while the share of crop production stands for 24% of the total volume of agricultural production. Wheat, oats and buckwheat are the major crops cultivated in the area (Altaistat).

Potential of natural forage crops in Charyshsky district is 8.01 units of uniform mass - the highest indicator in Krai, exceeding the similar one in Kulundinsky district by 100 times (for example in Pavlovsky district it is 2.42, and in Krasnogorsky district it is 3.30) (Vinokurov, 2010:93-94). Comparative figures of forages exhibit excellent natural conditions for the development of high-quality honey farming.

Beekeeping industry and crop production in some aspects are not possible without the development and broad-spectrum use of honeybee colonies. Proper use and care of bees as pollinators allows us to produce an abundance of buckwheat and sunflower seeds, to obtain perennial legumes and other crops. The pollinating efficiency and effectiveness of bees is a primary productivity factor. Crop production and beekeeping are closely linked together. Beekeeping is crucial for increasing the yield of cross-pollinated plants (Severin, 2016). Charyshsky district honey products are organically pure. Organoleptic analysis of honey samples through aroma-taste cross-modal perception revealed a leader in Western Siberia - sweet clover honey from mountain forest zone in Altai krai.

Conclusion

Green tourism is considered a growth industry and one of the most promising sectors in many districts of Altai Krai. Availability of organically pure honey products is taking a leading role in the development of Altai Krai economy. Charyshsky district has an extremely rich agrarian potential. By gradually increasing crop production we promote and support beekeeping industry and organic production. In the melliferous base of Charyshsky district locality there were identified 185 species of mellifers (19, 6% of total species number). Model plots of Charyshsky district refer to mountain forest zone and have the most stable honey harvest, due to a wide range of plants species. Melissopalynology studies exhibited that honey samples of Charyshsky district are polyfloral. The pollen composition of honey reflects the type of vegetation in the area. Midlands and lowlands with fir–aspen forests with tall herbaceous plants (black taiga) have very high melliferous potential. It should be noted that melliferous resources along with other types of vegetation resources are being destroyed as a result of human economic activity (arable land, grazing, forestry activities) therefore it is necessary to provide environmental resource management and resource efficiency approach.

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