Ecosystem of Medicinal Plants Species and Potential of Growing on the Dumps of Kedrovsky Surface Mine (Kemerovo Region)

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Annotation. The medicinal flora of phytocenosis "Yuzhny" waste dump Kedrovsky coal mine pit in Kemerovo region was   studied. It has been established that 51 species of medicinal plants belonging to 46 genus and 27 families grow on the waste dump. They are permitted for use in official medicine and included in the Medicines State Register in the territory of the Russian Federation. The most of medicinal plants species are represented by forest (39.22%), ruderal (27.45%) and meadow (23.53%) vegetation, which in general is 90.2% of the identified medicinal plants number. The share of semi-aquatic and steppe vegetation accounts for 7.84% and 1.96%, respectively. It has been established that perennial herbaceous plants (25 species) predominate in the life forms composition; shrubs and trees account for 7 and 9 species, respectively. Researches were established a group of medicinal plants with resource potential and interest in raw materials procurement. This group include 13 herbaceous plants (Achillea millefolium L., Viola arvensis Murr., Polygonum aviculare L., Melilotus officinalis (L.) Pall., Fragaria vesca L., Verbascum thapsus L., Urtica dioica L., Filipendula ulmaria (L.) Maxim., Tussilago farfara L., Taraxacum officinale Web., Tanacetum vulgare L., Plantago major L., Artemisia absinthium L.), 5 shurbs (Crataegus sanguínea Pall., Hippophaë rhamnoides L., Rosa accicularis Lindl., Rosa majalis Herm., Viburnum opulus L.) and 5 trees (Betula pendula Roth., Betula pubesccens Ehrh., Padus avium Mill., Sorbus sibirica Hedl., Pinus sylbestris L.).

1 Introduction

Kemerovo region coal-mining enterprises work entails a large loss of land resources. The natural habitats of many valuable wild plants, including medicinal plants and the area of their natural phytocenoses are reduced. The restoring processes of disturbed land are slow. Predominantly technogenic lands incur to natural overgrowing, due to the drift of seeds from the surrounding territories. Also a reclamation biological stage is carried out by planting trees and grass mixtures. The most commonly used tree and shrub species are: *Larix sibirica*

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Ledeb., *Pinus sylvestris* L., *Picea obovata* Ledeb., *Pinus sibirica* Du Tour., *Abies sibirica* Ledeb., *Betula pendula* Roth., *Populus balsamifera* L., *Hippophae rhamnoides* L., *Crataegus sanguínea* Pall., *Caragana arborescens* Lam., *Sambucus sibirica* Nakai., *Sorbus sibirica* Hedl., *Padus avium* Mill. and etc. From herbaceous plants in the planting mixture is injected: *Medicago* L., *Trifolium* L., *Galega orientalis* Lam., *Bromopsis inermis* (Leyss.) Holub., *Agropyron Intermidium* (Host.) Beauv., *Festuca pratensis* Huds., *Melilotus albus* Desr. and the medicinal plant *Melilótus officinális* L. etc [1-3]. Many of these species not only have the pronounced highly effective phytomeliorant properties that performs soil-protective and environment-forming functions, but also have certain pharmacological properties (*Hippophae rhamnoides* L., *Crataus sanguinea* Pall., *Melilótus officinális* L. etc.) [4,5]. In addition, a large number of introduced species (*Tussilago farfara* L., *Fragaria vesca* L., *Arctium lappa* L., *Plantago major* L., etc.) are found on the dumps, many of which are medicinal [4].

Phyto and zoocenoses are formed on the dumps over time, including species which typical for the area and the soil formation process is actively taking place. There is an improvement in the environmental situation. The earlier studies of environmental and hygienic assessment of the medicinal plants raw materials growing on the "Yuzhny" dump Kedrovsky coal mine are showed that it meets the requirements of regulatory documents and does not pose a danger to human life and health [6-12].

In this regard, the research of phytocenoses medicinal flora formed on the dumps of coal mines is seem to be perspective, cause it will increase the medicinal plant raw material base.

The purpose of this work is to study the medicinal flora species composition and resource potential of phytocenoses Kedrovsky coal mine dumps.

2 Materials and Methods

Studies were conducted on the "Yuzhny" waste dump of OJSC open-pit mine "Kedrovsky". Waste age is 35-40 years. Waste pile are represented by sandstone (60%), siltstones (20%), mudstones (15%), loams and clays (5%). According to the soils classification by N. A. Kachinsky, the waste young soils are medium loam [8]. Soils are characterized by alkaline reaction (pH of the aqueous extract is 7.1-7.7), medium supply of humus (3.5%), low availability of phosphorus mobile forms (10 ... 50 mg / kg) and nitrogen (3.6 ... 6.0 mg / kg), high availability of exchangeable potassium (100 ... 140 mg / kg), lack of productive moisture (19-22 mm in 0 ... 20 cm layer). Phytocenoses on the dumps are formed due to natural self-overgrowth and with biological remediation works complex (planting Pinus sylvestris L. and Onobrychis arenaria (Kit.) DC.). Studies have been conducted in various dump microreliefs. Projective cover up to 50%, on rocky areas - below 10%. There is no sodding. In the herbage prevail *Onobrychis arenaria* (Kit.) DC., *Taraxacum officinale* Wigg., *Melilotus officinalis* (L.) Pall., *Artemisia sericea* Web. ex Stechm., *Picris hieracioides* L. [13].

The research material was the medicinal plants flora of the Kedrovsky coal mine dump in the summer period of 2011-2014.

The main research methods are observations in nature and the herbarium material collection, herbarium collections analysis (FIC UUK SB RAS, KemSU) and literary sources analysis. The obtained data were processed using standard floristic analysis. Latin species names are given by Cherepanov (1995) [14-15].

3 Results and Discussion

In the course of research on dumps, 51 medicinal plants species belonging to 46 genus and 27 families allowed for use in official medicine in the territory of the Russian Federation were identified (Table 1). The most numerous is the Rosaceae family (10 species), then follows - Asteraceae (8 species), then - Apiaceae and Pinaceae (includes 3 species in each); Betulaceae, Polygonaceae, Lamiaceae includes 3 species and 1 species found in following families: Ranunculaceae, Solanaceae, Fabaceae, Papaveraceae, Urticaceae, Brassicaceae, Plantaginaceae, Eguisetaceae, Scrophulariaceae, Hypericaceae, Adoxaceae, Tiliaceae, Dryopteridaceae, Elaegnaceae, Paeoniaceae, Polemoniaceae, Grossulariaceae, Salicaceae, Melanthiaceae, Violaceae, Cannabineae (Fig 1.).

Table 1. Medicinal Plants Summary data.

N	Medicinal plant name	Family	Life-form	ECG	Raw material type
1.	Adonis vernalis L.	Ranunculaceae	PHP	meadow	herb
2.	Hyoscyamus niger L.	Solanaceae	BHP	ruderal	leaves
3.	Betula pendula Roth.	Betulaceae	T	forest	gemma, leaves
4.	Betula pubesccens Ehrh.	Betulaceae	T	forest	gemma, leaves
5.	Crataegus sanguinaea Pall.	Rosaceae	S	forest	flowers, fruits
6.	Centaurea cyanus L.	Asteraceae	OT	ruderal	flower
7.	Bupleurum multinerve DC.	Apiaceae	MT	meadow	herb
8	Polygonum aviculare L.	Polygonaceae	AHP	ruderal	herb
9.	Polygonum hydropiper L.	Polygonaceae	AHP	semi-aquatic	herb
10.	Peucedanum morisonii Bess.ex Spreng.	Apiaceae	PHP	steppe	roots
11.	Melilotus officinalis (L.) Pall.	Fabaceae	BHP	ruderal	herb
12.	Origanum vulgare L.	Lamiaceae	PHP	meadow	herb
13.	Hypericum perforatum L.	Hypericaceae	PHP	meadow	herb
14.	Fragaria vesca L.	Rosaceae	PHP	forest	leaves, fruits
15.	Viburnum opulus L.	Adoxaceae	S	forest	fruits, cortex
16.	Pinus sibirica Ledep.	Pinaceae	T	forest	strobile
17.	Verbascum thapsus L.	Scrophulariaceae	BHP	ruderal	flowers
18.	Urtica dioica L.	Urticaceae	PHP	ruderal	leaves
29.	Sanguisorba officinalis L.	Rosaceae	PHP	meadow	rhizomes and roots
20.	Filipendula ulmaria (L.) Maxim.	Rosaceae	PHP	meadow	flowers
21.	Potentilla argentea L.	Rosaceae	PHP	forest	herb
22.	Tilia cordata Mill.	Tiliaceae	T	forest	flowers
23.	Arctium lappa L.	Asteraceae	PHP	ruderal	кroots
24.	Rubus idaeus L.	Rosaceae	S	forest	fruits
25.	Tussilago farfara L.	Asteraceae	PHP	ruderal	leaves, flowers
26.	Dryopteris filix- mas (L.) Schott.	Dryopteridaceae	PHP	forest	rhizome

27.	Hippophae rhamnoides L.	Elaeagnaceae	S	semi-aquatic	плоды
28.	Taraxacum officinale Web.	Asteraceae	PHP	ruderal	roots
29.	Capsélla bursa pastóris (L.) Medik.	Brassicaceae	AHP	ruderal	herb
30.	Tanacetum vulgare L.	Asteraceae	PHP	meadow	flowers
31.	Paeonia anomala L.	Paeoniaceae	PHP	forest	herb, rhizomes and roots
32.	Abies sibirica Ledeb.	Pinaceae	T	forest	needle, gemma, branch, cortex
33.	Plantago major L.	Plantaginaceae	PHP	meadow	leaves
34.	Artemisia absinthium L.	Asteraceae	PHP	ruderal	herb, leaves
35.	Leonurus guinguelobatus Gilib.	Lamiaceae	PHP	ruderal	herb
36.	Sorbus sibirica Hedl.	Rosaceae	T	forest	fruits
37.	Polemónium caeruléum L	Polemoniaceae	PHP	forest	rhizomes and roots
38.	Pinus sylbestris L.	Pinaceae	T	forest	gemma, needle
39.	Ribes nigrum L.	Grossulariaceae	K	forest	fruits
40.	Carum carvi L.	Apiaceae	BHP	meadow	seeds
41.	Populus nigra L.	Salicaceae	T	semi-aquatic	gemma
42.	Achillea millefolium L.	Asteraceae	PHP	meadow	herb, flowers
43.	Chelidonium majus L.	Papaveraceae	PHP	ruderal	herb
44.	Veratrumm lobelianum Bernh.	Melanthiaceae	PHP	forest	rhizomes and roots
45.	Bidens tripartita L.	Asteraceae	AHP	semi-aquatic	herb
46.	Padus avium Mill.	Rosaceae	T	forest	fruits
47.	Viola arvensis Murr.	Violaceae	AHP	ruderal	herb
48.	Eguisetum arvense L.	Equisetaceae	PHP	meadow	herb
49.	Humulus lupulus L.	Cannabineae	PHP	forest	seedlings
50.	Rosa majalis Herm.	Rosaceae	S	meadow	fruits
51.	Rosa accicularis Lindl.	Rosaceae	S	forest	fruits

Notes: LF - life forms, T - trees, S - shrubs, PHP - perennial herbaceous plants, BHP - biennial herbaceous plants, AHP - annual herbaceous plants, ECG - ecological cenotic groups.
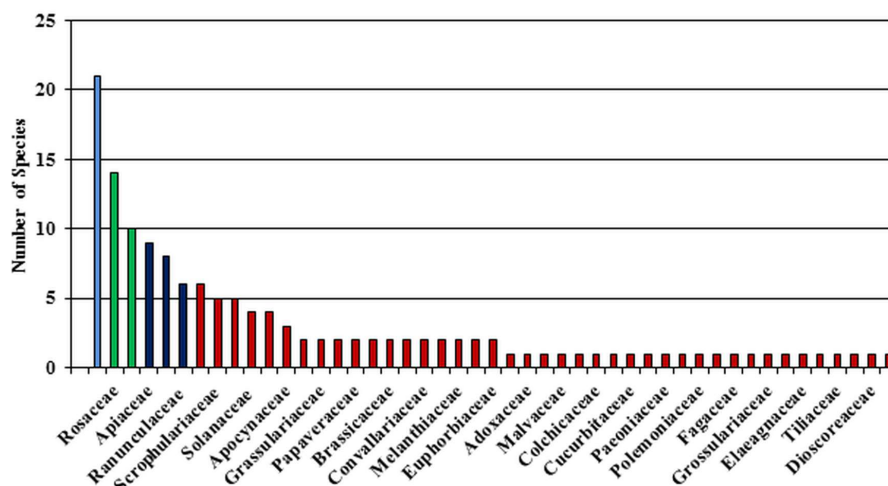
Fig.1. The medicinal plants species distribution by families.

The dump medicinal flora ecological-cenotic groups analysis showed that forest (20 species), ruderal (14 species) and meadow (12 species) vegetation prevail in the phytocenosis structure - 39.22; 27.45 and 23.53%, which overall makes up 90.20% of the identified medicinal plants total number. The share of semi-aquatic vegetation (4 species) and steppe vegetation (1 species) accounts for 7.84% and 1.96%, respectively (Table 1, Fig. 2).
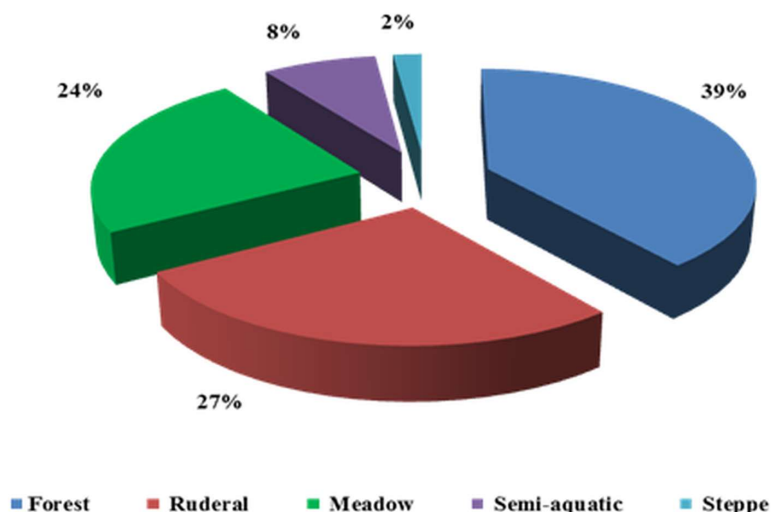

Fig.2. Medicinal plants distribution by ecological-cenotic groups.

The medicinal flora analysis showed that herb plants prevail, of which 49.02% (25 species) are perennial herbaceous plants (PHP), 9.8% (5 species each) biennial and annual plants (BHP,AHP), 13 , 73% (7 species) - bushes (S) and 13.65% (9 species) - trees (T) (Fig. 3).
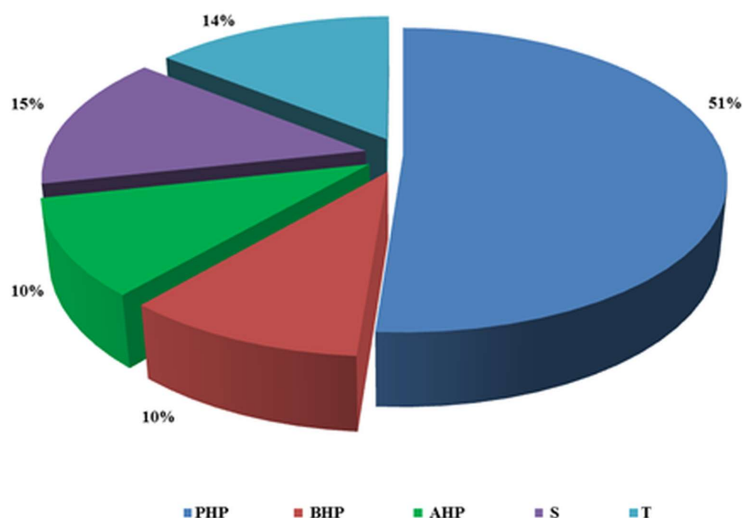
Fig. 3. The medicinal plants life forms composition.

23 species which often form thickets are interesting for resource studies and for raw material procurement (Table 2).

It is possible to harvest various types raw materials of medicinal plants identified on waste dumps. For example, in 11 types of herbaceous perennials the aboveground part (herb) is used as a raw material. In a significant part, underground organs are harvested (8 species), in 4 species - flowers and inflorescences, in 5 - leaves, and in 1 species - fruits and seedlings. In most cases in annual plants harvest herb - 5 species; in one species, flowers. Biennial herbaceous plants harvest seeds, fruits, flowers, leaves and grass.

Table 2. The forming thickets medicinal plant group identified on the dumps.

Medicinal plant Latin names	Life forms
Achillea millefolium L. Viola arvensis Murr. Polygonum aviculare L. Melilotus officinalis (L.) Pall. Fragaria vesca L. Verbascum thapsus L. Urtica dioica L. Filipendula ulmaria (L.) Maxim. Tussilago farfara L. Taraxacum officinale Web. Tanacetum vulgare L. Plantago major L. Artemisia absinthium L.	Herbaceous plants
Crataegus sanguínea Pall. Hippophaë rhamnoides L. Rosa accicularis Lindl. Rosa majalis Herm. Viburnum opulus L.	Shrubs

Betula pendula Roth. Betula pubesccens Ehrh. Padus avium Mill. Sorbus sibirica Hedl. Pinus sylbestris L.	Trees

13 species of herbaceous plants, 5 species of shrubs and 5 species of trees are form thickets.

In contrast to herbaceous plants, tree forms and shrubs often use fruits, buds, leaves, shoots, bark, flowers, and inflorescences as raw materials (Table 1).

It also should be noted that medicinal plants growing on the studied dump used in homeopathy and being raw materials for dietary supplements. These are more than 60 species of plants (*Geranium pratense* L., *Convolvulus arvensis* L., *Erysimum cheiranthoides* L., Salix alba L., *Trifolium pratense* L., *Potentilla anserina* L., *Pulmonaria obscura* Dumort., Etc.) [16].

4 Conclusion

The Kedrovsky mine waste dump "Yuzhny" phytocenosis, there are 51 medicinal plants species belonging to 46 genus and 27 families permitted for use in official medicine in the territory of the Russian Federation.

The ecological-cenotic groups analysis of dump medicinal flora showed that forest, ruderal and meadow vegetation prevails in the structure of phytocenosis, which is 39.22; 27.45 and 23.53%, respectively. The share of semi-aquatic and steppe vegetation accounts for 7.84% and 1.96%, respectively.

The life forms composition is dominated by perennial herbaceous plants (25 species); shrubs and trees of 7 and 9 species, respectively.

Research has established a medicinal plants group with resource potential and the raw materials procurement interest. It includes 13 species of herbaceous plants, 5 species of shrubs and 5 species of trees.

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