Phytocenotic characteristics and reserves of the main medicinal plants of the northern slopes of the Alay Range (Kyrgyzstan)

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Abstract. The Kyrgyz way of life is closely connected with plants. Local residents unsustainably use pastures and plants used in traditional medicine, which leads to the extinction of some species. Therefore, studying the current state of the local flora is one of the relevant tasks of modern science. The article presents the results of a study on the biological and operational reserves of the medicinal plant fern-leaf yarrow, which is often found on the northern slopes of the Alay Range. The number (abundance) of species was estimated. The distribution of plants in the study area was determined according to special criteria. The yield was calculated using arithmetic formulas. The result of research on a total area of 12.3 hectares was the characterization of the association of four plant coenopopulations and the identification of reserves of St. John's wort, fern-leaf yarrow and common chicory. The results of this work can be used in teaching students and postgraduates in biological and pharmaceutical specialties. Also used in licensing companies involved in the collection of medicinal plants.

1 Introduction

We all know that people's lifestyle is closely related to nature, so it has different effects on plants. Irrational use of pastures (increase in arable land, livestock numbers) leads to a decrease in areas and types of useful plants. The experience of the Kyrgyz people in using plants is also diverse (medicine, food, dyes, anti-pests, etc.), so research is necessary to preserve biodiversity and rational use. It is necessary to conduct a comprehensive resource expedition to all regions of our country and organize the rational use of plant biodiversity. Many problems related to the use of wild plants of the local flora have led to the study of the resources of useful plants. Therefore, one of the pressing problems of our time is the assessment and accounting of the natural reserves of medicinal plants of the republic, the organization of their rational use, protection and reproduction. Such research attracts the

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attention of the general public to the issues of biodiversity conservation, ecosystem preservation, and the search for more sustainable ways of living in harmony with nature [2].

2 Materials and Methods

The object of the study is the useful plants growing in the middle part of the northern slopes of the Alay Range (mountainous areas of the Kara-Suu and Nookat districts), often used in traditional medicine: *Hypericum perforatum* L., *Achillea filipendulina* Lam., *Cichorium intybus* L. The classification of vegetation cover of the formation is based on the widely spread ecological-phytocenotic principle. The composition of edificators and subedificators, the dominant ecobiomorph, species composition, community structure, and layering of herbaceous plants were studied by criteria [3, 7, 9, 10].

The species composition was determined using the Flora Inventory of Kyrgyzstan (2014), Flora of the Kyrgyz SSR, and Guide to the Plants of the Kyrgyz SSR by Vykhodtsev I.V. When describing plant communities, geobotanical methods were used with a visual assessment of the number of species (abundance) on the G. Drude scale, set out in the work of B. A. Bykov [1, 6]. To determine the resource potential of medicinal plants, a generally accepted method was used: "Methodology for determining the reserves of medicinal plants" by the method of sample plots by I. L. Krylov, A.I. Shreter Approved by the USSR State Committee for Forestry, the Ministry of Medical and Microbiological Industry [3, 5, 8].

3 Results and Discussion

We know that for effective planning and rational use of wild medicinal plant resources, specific information about their condition and location is required, which is achieved through field research of territories. Various herbaceous meadows, shrubby thickets, and wild medicinal plants of the flora of the juniper forests of the highlands are of interest to local folk healers and scientific research institutes. One of the objectives of our research was to identify the raw material base of medicinal plants. As a result of field research, natural reserves of raw materials of the studied plant species were determined.

The research was conducted in the Achyksay tract, Kayyrma, Kichik, and the foothills of Taiyr on the northern slope of the Alay Range.

Four cenopopulations of plants were studied in the growing areas of *Achillea filipendulina + Hypericum perforatum + Cichorium intybus*. Their characteristic associations:

1. Wormwood - Eremurus - St. John's wort (ass. *Hypericum perforatum + Eremurus kaufmannii - Artemisia dracunculus*);

2. Bluegrass - Gundelia - St. John's Wort Association (Ass. *Hypericum perforatum + Handelia trichophylla + Poa pratensis*);

3. Gundelia - Milkwort - Yarrow Association (Ass. *Achillea filipendulina + Euphorbia jaxartica + Handelia trichophylla*);

4. Wormwood - - Brome - Chicory Association (ass. Ass. *Cichorium intybus + Brōmus inērmis + Artemisia absinthium*).

1. Wormwood - Eremurus - St. John's wort (ass. *Hypericum perforatum + Eremurus kaufmannii - Artemisia dracunculus*) association is located in the northwestern part of the Achyksay tract at absolute altitudes of 1600-1650 m above sea level. Slopes with a steepness of 20-25° are presented with northwestern exposures.

Species composition of shrubs *Caragana turkestanica, Lonicera hispida* Sol*., Rosa alberti, Rosa laxa* with an abundance of Un. Edificators of grass cover - *Artemisia dracunculus, Eremurus kaufmannii, Hypericum perforatum,* with an abundance of Cop_1. Coedificators *Artemisia absinthium, Centaurea ruthenica, Achillea filipendulina* , *Zizihora*

clinopodioides Convolvulus arvensi, Deschampsia caespitosa, Dracocephalum integrifolium, etc. with an abundance of Sp. Assectators *Urtica dioica, Plantago major, Festuca alaica, Onopordum acanthium,* etc. The grass stand is three-layered. The first layer (90-120 cm) is composed of *Alcea nudiflora, Onopordum acanthium*. The height of the plants of the second layer is 40-80 cm, they are *Achillea filipendulina, Alchemilla krylovii, Centaurea ruthenica, Bidens tripartita, Urtica dioica, Acroptilon repens, Festuca alaica*, etc. The third layer (15-35 cm) is composed of *Arenaria leptoclados*, *Blysmus compressus, Scutellaria adenostegia, Silene brahuica, Convolvulus arvensis, Trigonella arcuate, Plantago major*, etc. In this area, thickets *of Hypericum perforatum* are distributed unevenly; it grows in separate areas, forming dense thickets. The floristic composition of the community is represented by 47 species (Table 1).

Table 1. Floristic composition ass. *Hypericum perforatum+ Eremurus kaufmannii - Artemisia dracunculus*) (22.06.-22. 07. 2022-2023)

Name of species	**Abundance of species by Drude**	**Vegetation phase**	**Level**
Achillea filipendulina	Cop1.	fl_2.	II
Alchemilla krylovii	Sol	fl_2.	II
Arenaria leptoclados	Sol.	fl_2.	III
Artemisia absinthium	Sp.		II
Acroptilon repens	Sol.	fl_2.	II
Artemisia dracunculus	Cop1.	fl_2.	II
Astragalus camptoceras	Un.	fl_2.	III
Bidens tripartita	Sol.	bud.	II
Blysmus compressus	Sol.	bud.	III
Bothriochloa ischaemum	Sol.	fl. fr.	II
Bromopsis inermis	Sp.	fl_3. fr_1.	II
Bupleurum ferganense	Sol.	fl_3. fr_1.	II
Capsella bursa postoris	Sol.	fl_3. fr_1..	II
Caragana turkestanica	Sol.	fl_3. fr_1.	I
Cardaria repens	Sol.	fl_2.	II
Carex pseudofoetida	Sol.	fr_1.	III
Carum vulgaris	Sol.	fl_2.	II
Centaurea ruthenica	Sp.	bud. fr_1.	II
Cerastium holosteoides	Un.	fl.	III
Chalcanthus renifolius	Un.	fl_3. fr_1.	II
Cirsiumin canum	Un.	fl_2.	II
Convolvulus arvensis	Sp.	fl_2.	III
Deschampsia caespitosa	Sp.	fl_3. fr_1.	II
Dracocephalum integrifolium	Sp.	fl_2.	III
Eremurus kaufmannii	Cop1.	fl_3. fr_1.	II
Festuca alaica	Sol.	fl_3. fr_1.	II
Galium spurium	Sp.	fl_2.	III
Geranium saxatile	Sol.	fl_2.	II
Hypericum perforatum	Sol.	fl_2.	II
Ligularia thomsonii	Sol.	fl_2.	II
Lithospermum arvense	Sol.	fl_2.	II
Lonicera hispida	Sol.	fl_2.	I
Microcephala lamellata	Sp.	fl_2.	III
Onopordum acanthium	Un.	fl_2.	II
Plantago major	Un.	fl_3. fr_1.	III
Phlomoides oreaphila	Sol.	fl.	II
Polygonum persicaria	Sol.	bud. fl_1.	II

Potentilla algida	Un.	fl_2.	III
Rosa alberti	Un.	fl_2.	I
Rosa laxa	Un.	fl_2.	I
Scutellaria adenostegia	Sol.	fl_2.	III
Silene brahuica	Sol.	fl_2.	III
Thalictrum simplex	Sol.	fl_3. fr_1.	I
Trigonella arcuate	Sol.	fl_2.	III
Urtica dioica	Sol.	fl_2.	II
Valerianella plagiostephana	Un.	fl_2.	II
Ziziphora clinopodioides	Cop1.	fl_2.	III

Wormwood - Eremurus - St. John's wort (ass. *Hypericum perforatum + Eremurus kaufmannii - Artemisia dracunculus*) association is 10.8 hectares. Projective vegetation cover is 55-60%, of which *Achillea filipendulina is 10-15*%. Yield - 0.296 + 0.010 kg/ha, Operating reserve of air-dry material - 330.4 kg. The annual harvest volume is 108.9 kg (Table 5).

2. Bluegrass - Gandelia - St. John's Wort association (Ass. *Hypericum perforatum + Handelia trichophylla + Poa pratensis*)association is located in the northern part of the Kaiyrma tract at absolute altitudes of 1500-1600 m above sea level. The slopes are 10-20° steep and have northwestern exposures. Edificators of herbaceous plants in the phytocenosis *are Hypericum perforatum, Handelia trichophylla, Poa pratensis, Poa diaphora*, *Poa angustifolia.*The abundance of these plants was measured by Cop_1.Coedificators Sp *Alchemilla retropilosa, Hypericum perforatum, Onopordum acanthium, Melissitus adscendens, Portulaca oleracea, Turritis glabra, Salvia deserta, Veronica biloba, Xanthium spinosum* etc. Assectators: *Agropyron himalayanum, Avena trichophylla, Blysmus compressus, Bromopsis inermis, Convolvulus lineatus, Festuca coelestis, Onopordum acanthium, Plantago major, Poa angustifolia, Poa pratensis,* etc. *Hypericum perforatum* is distributed unevenly in this area. The floristic composition of the community is represented by 61 species of flowering plants (Table 2).

Table 2. Floristic composition ass. *Hypericum perforatum + Handelia trichophylla + Poa pratensis* (20.06.-20. 07. 2022-2023)

Name of species	**Abundance of species by Drude**	**Vegetation phase**	**Level**
Acanthocephalus benthamianus	Sol.	fl_2.	III
Achillea filipendulina	Un.	fl_2.	II
Aconitum nemorum	Un.	bud.fl_1.	II
Agropyron himalayanum	Sol.	fl_3. fr_1.	II
Agrostis stolonifera	Sol.	bud.	II
Alcea nudiflora	Sp.-Sol.	fl_2.	I
Alchemilla retropilosa	Sp.	bud.fl_1.	III
Alopecurus pratensis	Sol.	fl_2.	II
Alyssum dasycarpum	Un.	fl_2.	III
Anthriscus sylvestris	Sol.	fl_2.	I
Artemisia dracunculus	Sol.	fl_2.	II
Asperula aparine	Sol.	fl_2.	II
Asperula arvensis	Un.	fl_2.	II
Astrogalus alpinus	Un.	fl_2.	II
Avena meridionalis	Sol.	fl_2.	II
Avena trichophylla	Sol.	fl_2.	II
Valeriana ficariifolia	Un.	fl_2.	II
Bunium persicum	Un.	fl_2.	II
Blysmus compressus	Sp.	fl_2.	III
Bromopsis inermis	Sp.	fl_3.fr.	II
Bupleurum ferganense	Sol.	fl_3.fr_1.	II

Camelina microcarpa	Sol.	fl_2.	II
Camelina silvestris	Sol.	fl_2.	II
Carex enervis	Sol.	$fl_3.fr_1$.	III
Carex parva	Sol.	fl.fr.	III
Carum vulgaris	Sp.	fl.	II
Cichorium intybus	Un.	fl_2.	II
Convolvulus lineatus	Sp.	fl_2.	III
Chondrilla lejosperma	Sol.	fl_2.	II
Daucus carota	Sol.	fl_2.	II
Erysimum humillimum	Sol.	fl_2.	III
Euphorbia jaxartica	Un.-Sol.	fl_2.	I
Festuca coelestis	Cop1.	$fl_3.fr_1$.	II
Galium turkestanicum	Un.-Sol.	fl_2.	II
Gastrocotyle hispida	Un.-Sol.	fl_2.	III
Handelia trichophylla	Cop1.	$fl_3.fr_1$.	II
Hieracium procerum	Sol.	fl_2.	II
Hypericum perforatum	Cop1.	fl_2.	II
Hypericum scabrum	Sol.	fl_2.	II
Lepidium crassifolium	Sol.	$fl_3.fr_1$.	II
Lycopus europaeus	Sol.-Sp.	$fl_3.fr_1$.	II
Melissitus adscendens	Sp.	$fl_3.fr_1$.	III
Onopordum acanthium	Sp.	$bud.fl_1$.	I
Peganum harmala	Sol.	fl_2.	II
Phlomoides alaica	Sol.-Sp.	fl_2.	II
Phlomoides oreophila	Sol.	fl_2.	II
Plantago major	Un.	fl.fr.	III
Poa angustifolia	Cop1.	fl_2.	II
Poa diaphora	Cop1.	fl.fr.	III
Poa pratensis	Cop1.	fl_2.	II
Portulaca oleracea	Sp.	$bud.fl_1$.	III
Rhaponticum lyratum	Sol.	$bud.fl_1$.	II
Rubia tinctorum	Sol.	fl_2.	II
Salvia deserta	Sp.	$fl_3.fr_1$.	II
Senecio jacobaea	Un.	fl_2.	II
Stellaria media	Un.	fl_2.	II
Thalictrum simplex	Un.	$fl_3.fr_1$.	I
Turritis glabra	Sp.	fl_2.	III
Veronica biloba	Sp.	fl_2.	III
Vicia tenuifolia	Sol.	$fl_3.fr$.	I
Xanthium spinosum	Sp.	$fl_3.fr$.	II

Bluegrass - Gandelia - St. John's Wort association (Ass. *Hypericum perforatum* + *Handelia trichophylla* + *Poa pratensis*) association is 2.7 ha. Projective vegetation cover is 65-70%, of which *Hypericum perforatum* is 20-25%. Yield - 0.194 + 0.014 kg/ha, operational reserve of air-dry raw materials is 340.0 kg, annual harvest volume is 64.6 kg (Table 5).

3. Gundelia - Milkwort - Yarrow Association (Ass.*Achillea filipendulina* + *Euphorbia jaxartica* + *Handelia trichophylla*) association is located in the northwestern part of the Kichik tract at absolute altitudes of 1800-1900 m above sea level. Slopes with a steepness of 25-30° are presented with northwestern exposures. Community edificators *Achillea filipendulina, Euphorbia jaxartica* Cop_2*, Handelia trichophylla* with an abundance of Cop1. Coedificators *Hypericum perforatum, Phalaroides oreophila, Poa annua, Bupleurum krylovianum, Elymus kronenburgii, Stellaria soongorica*, *Rumex halacsyi*, etc. with an abundance of Sp. Assectators are *Urtica dioica, Plantago major, Carex diluta, Festuca coelestis*, etc. The grass stand is three-layered. The first layer is composed of *Rumex halacsyi,*

Alcea nudiflora, Inula helenium, Conium maculatum. The height of plants of the second layer is: *Achillea filipendulina, Euphorbia jaxartica, Handelia trichophylla, Achillea asiatica, Achillea sibirica, Urtica dioica, Acroptilon repens, Festuca alaica*, etc.The third layer is composed of: *Silene brahuica, Trigonella arcuate, Plantago major*, etc. The total number of plants in the community is 63 (Table 3).

Table 3. Floristic composition ass. *Achillea filipendulina + Euphorbia jaxartica + Handelia trichophylla* (20.06.-20. 07. 2022-2023)

Name of species	Abundance of species by Drude	Vegetation phase	Level
Acanthocephalus benthamianus	Sol.	fl_2.	III
Achillea filipendulina	Cop2.	fl_2.	II
Achillea sibirica	Un.	fl_2.	II
Agropyron cristatum	Cop1.	fr_2.	II
Agropyron schrenkianum	Sp.-Cop1.	fl_2.	II
Alcea nudiflora	Un.	fl_2.	I
Artemisia dracunculus	Sol.	fl_2.	II
Avena trichophylla	Sol.	fl_2.	II
Bunium chaerophylloide	Sol.	fl_2.	II
Brassica elongate	Sol.	fl_3. fr_1.	II
Brassica elongate	Sol.	fl_2. fr_1.	II
Bupleurum ferganense	Sol.	fl_2. fr_1.	II
Bupleurum krylovianum	Sp.	fl_3. fr_1.	II
Carex diluta	Sol.-Sp.	fl_3. fr_1.	II
Camelina sylvestris	Sol.	fl_3. fr_1.	II
Cerastium holosteoides	Un.	fl_2.	III
Conium maculatum	Sol.	fl_2.	I
Chenopodium botrys	Un.	bud. fl_1.	II
Cuscuta gigantea	Un.	fl_2.	III
Dianthus tetralepis	Un.	fl_2.	III
Elymus kronenburgii	Sp.	fl_3. fr_1.	II
Erysimum marschallianum	Sol.	fl_2.	II
Euphorbia jaxartica	Cop1.	fl_2.	I
Festuca coelestis	Sp.	fl_3. fr_1.	II
Fumaria vaillantii	Sol.	fl_3. fr_1.	III
Galium tricornutum	Un.-Sol.	fl_2.	II
Glycyrrhiza uralensis	Sol.	fl_2.	I
Gypsophila perfoliata	Un.	fl_2.	III
Handelia trichophylla	Cop1.	fl_3. fr_1.	II
Haplophyllum pedicellatum	Sol.	fl_3. fr_1.	II
Hypericum perforatum	Sp.	fl_2.	II
Inula helenium	Sol.	fl_2.	I
Kobresia persica	Sol.-Sp.	fl_3. fr1.	III
Lycopus europaeus	Sol.-Sp.	fl_3. fr_1.	II
Malva neglecta	Sol.-Sp.	fl_3. fr_1.	II
Neslia apiculata	Sp.	fl_2.	II
Nepeta podostachys	Sol.	fl_2.	III
Origanum tyttanthum	Sol.	fl_2.	II
Oxytropis glabra	Sol.	fl_2.	II
Parietaria judaica	Sol.	fl_2.	II
Plantago major	Un.	fl_2. fr_1.	III
Poa diaphora	Cop1.	fl. fr.	III
Poa annua	Sp	fl_2. fr_1.	III
Potentilla asiatica	Un.	fl_2.	II

Potentilla gelida	Un.	bud. fl.	III
Ptilagrostis mongholica	Cop1.	fl_3. fr_1.	II
Rubia tinctorum	Sol.	fl_2.	II
Rumex halacsyi	Sp.	fl_2.	I
Salvia deserta	Sol.	fl_2. fr_1.	II
Salvia spinosa	Sol.	fl_2.	II
Scutellaria galericulata	Sol.	fl_3. fr_1.	III
Setária verticillata	Sol.	fl_3. fr_1.	II
Stellaria soongorica	Sp	fl_3. fr_1.	II
Sonchus asper	Un.	fl_2.	II
Silene vulgaris	Sol.	fl_2.	II
Sisymbrium officinale	Sol.	fl_2.	II
Stachys betoniciflora	Sol.	fl_2.	II
Stellaria brachypetala	Sol.	fl_2.	III
Suaeda linifolia	Un.	fl_3. fr_1.	II
Thlaspi arvense	Sol.	fl_3. fr_1.	II
Thlaspi perfoliatum	Sol.	fl_3. fr.	II
Urtica dioica	Sol.	fl_2.	II
Valerianella oxyrrhyncha	Sol.	fl_2.	II

Gundelia - Milkwort - Yarrow Association (Ass.*Achillea filipendulina* + *Euphorbia jaxartica* + *Handelia trichophylla*) association is 4.6 hectares. Projective vegetation cover is 75-80%, of which *Achillea filipendulina* is 20-25%. Yield - 0.357 + 0.026 kg/ha, operational reserve of air-dry raw materials - 1403.0 kg. The annual harvest volume is 275.3 kg (Table 5).

4. Wormwood - - Brome - Chicory Association (ass. Ass. *Cichorium intybus* + *Brōmus inērmis* + *Artemisia absinthium*) association is located in the northwestern part of the Tayyr foothills at absolute altitudes of 1200-1250 m above sea level. Slopes with a steepness of 30-35° are presented with northern and northwestern exposures. Herbaceous edificators *Handelia trichophylla, Agropyron trichophorum, Alopecurus pratensis, Artemisia dracunculus, Bromus gracillimus, Bromus inermis, Carex diluta, Cichorium intybus, Festuca alaica, Festuca rubra, Setária viridis, Hierochloe odorata, Setária viridis* with an abundance of Cop_1. Coedificators *Centaurea squarrosa, Convolvulus arvensis, Deschampsia caespitosa, Dracocephalum integrifolium, Elymus dasystachus, Microcephala lamellatab Onopordum acanthium* with an abundance of Sp. The following act as assectators: *Urtica dioica, Plantago major, Festuca altaica, Onopordum acanthium*. *Achillea millefolium, Artemisia absinthium, Acroptilon repens, Barbarea vulgaris, Bothriochloa ischaemum, Cnicus benedictus, Onopordum acanthium, Hordeum bulbosum g.b.* Sol*, Artemisia annua, Conium maculatum, Verbascum thapsus* and others with an abundance of Un. The grass stand is three-layered. The first layer consists of *Onopordum acanthium, Verbascum thapsus*. The height of the plants of the second layer is 45-80 cm, it consists of *Achillea filipendulina, Urtica dioica, Acroptilon repens, Festuca altaica* l.b. The third layer (15-35 cm) consists of *Silene brahuica, Trigonella arcuate, Plantago major, Potentilla conferta, Trollius altaicus*, etc. The total number of plants in the community is 57 (Table 4).

Table 4. Floristic composition ass. *Artemisia absinthium + Cichorium intybus + Brōmus inērmis)* (20.06.-20. 07. 2022-2023)

The name of the plant	**Frequency**	**Phenophase**	**Tier**
Agropyron trichophorum	Cop1.	fl_2	II
Achillea millefolium	Sol.	fl_2	II
Achillea filipendulina	Un.	fl_2	II
Alopecurus pratensis	Cop1.	fl_2	II
Acroptilon repens	Sol.	fl_2	II

Alcea nudiflora	Un.	fl_2	I
Artemisia absinthium	Cop1.	fl_2	II
Artemisia annua	Un.	fl_2	II
Astragalus tibetanus	Un.	fl_2	II
Barbarea vulgaris	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Bidens tripartita	Un.	bud.	II
Bothriochloa ischaemum	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Bromus gracillimus	Cop1.	$fl_{3.}$ - $fr_{1.}$	II
Bromus inermis	Cop1.	$fl_{3.}$ - $fr_{1.}$	II
Bupleurum exaltatum	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Cardaria repens	Sol.	fl_2	II
Carex diluta	Cop1.	fl.	II
Campanula glomerata	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Capsella bursa postoris	Sol.	$fl_{3.}$ - $fr_{1.}$	III
Cardaria repens	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Cardamine impatiens	Sol.	fl_2	II
Carex diluta	Cop1.	fl.	II
Carum carvi	Sol.	fl_2	II
Centaurea squarrosa	Sp.	bud. - $fl_{1.}$	II
Conium maculatum	Un.	fl_2	I-II
Cnicus benedictus	Un.	$fl_{3.}$ - $fr_{1.}$	II
Cichorium intybus	Cop1.	fl_2	II
Convolvulus arvensis	Sp.	fl_2	III
Descurainia sophia	Sp.	$fl_{3.}$ - $fr_{1.}$	II
Dracocephalum integrifolium	Sp.	fl_2	III
Dianthus superbus	Sol.	fl_2	II
Echium vulgare	Sol.	fl_2	II
Elymus dasystachus	Sp.	fl_2	II
Erysimum diffusum	Sol.	fl_2	II
Festuca altaica	Cop1.	$fl_{3.}$ - $fr_{1.}$	II
Festuca rubra	Cop1.	$fl_{3.}$ - $fr_{1.}$	II
Geranium collinum	Sol.	fl_2	II
Hierochloe odorata	Cop1.	$fl_{3.}$- $fr_{1.}$	II
Hordeum buldosum	Sol.	fl_2	II
Hyoscyamus niger	Un.	fl_2	II
Lappula microcarpa	Sol.	fl_2	II
Microcephala lamellata	Sp.	fl_2	III
Onopordum acanthium	Sp.	fl_2	II
Onobrychis arenaria	Un.	fl_2	I
Plantago major	Sol.	$fl_{3.}$- $fr_{1..}$	III
Phlomoides oreaphila	Sol.	fl_2	II
Polygonum persicaria	Sol.	bud.- $fr_{1.}$	II
Potentilla conferta	Un.	fl_2	III
Setária viridis	Cop1	fl_2	II
Silene brahuica	Sol.	fl_2	III
Sonchus asper	Sol.	$fl_{3.}$ - $fr_{1.}$	II
Thalíctrum foetidum	Sol.	$fl_{3.}$ - $y_{1.}$	II
Trollius altaicus	Sol.	fl_2	III
Urtica dioica	Sol.	fl_2	II
Valerianella diodon	Sol.	fl_2	II
Verbascum thapsus	Un.	fl_2	I
Veronica biloba	Sol.	$fl_{3.}$ - fr_1	III

Wormwood - - Brome - Chicory Association (ass. Ass. *Cichorium intybus* + *Brōmus inērmis* + *Artemisia absinthium*) association is 2.8 hectares. Projective vegetation cover is 65-70%, of which *Cichorium intybus* is 30-35%. Yield – 0.138±0.010 kg/ha. The operational reserve of air-dry material is 330.4 kg. The annual harvest volume is 66.8 kg (Table 5).

Raw material reserves and yields of *Hypericum perforatum, Achillea filipendulina, Cichorium intybus* in various communities along the northern slope of the Alay Range, in terms of air-dry raw materials (Table 5).

Table 5. Raw material reserves of *Hypericum perforatum* L., *Achillea filipendulina* Lam., *Cichorium intybus* L. (aerial part) in various communities of the northern slope of the Alay Range (in terms of air-dry raw materials)

Research area	Number of thickets	Total area, ha	Yield, kg/m^2	Operational reserve, kg	Annual harvest volume, kg
St. John's wort – *Hypericum perforatum* L.					
Achyksay tract	5	2.2	0.296 ± 0.010	330.4	108.9
Kaiyrma tract	4	2.7	0.194 ± 0.014	340.0	64.6
Fern-leaf yarrow - *Achillea filipendulina* Lam.					
Kichik Tract	4	4.6	0.357 ± 0.026	1 403.0	275.3
Common chicory - *Cichorium intybus* L.					
Tayyr Foothills	2	2,8	0.138 ± 0.010	330.4	66.8

4 Conclusions

The ecological and phytocenotic characteristics of the identified habitats are given in *the Hypericum perforatum* formation - two groups of associations, in the *Achillea filipendulina* formation of one group of associations and in *the Cichorium intybus* formation of one group of associations, in which they act as dominants and subdominants. Edificators and subedificators in the formation, phenophase, abundance, and layering of species are shown. The accounting of raw material reserves of medicinal plants of the studied species is given. The main areas of industrial thickets of *Hypericum perforatum*, *Achillea filipendulina*, *Cichorium intybus* and their productivity in meadow-steppe belts on the northern slope of the Alay Range have been determined.

The total area of the *Hypericum perforatum* thicket of the Achyksay tract is 2.2 hectares, the average yield is 0.296 ± 0.010 kg/ha, the operational reserve is 330.4 kg, the annual harvest volume is 108.9 kg, the area of the Kaiyrma tract is 2.7 hectares, the average yield is 0.194 ± 0.014 kg/ha, the operational reserve is 340.0 kg, the annual harvest volume is 64.6 kg. *Achillea filipendulina* is 4.6 hectares, the average yield is 0.357 ± 0.026 kg / ha, the operational reserve is 1403.0 kg, the annual harvest volume is 275.3 kg. *Cichorium intybus* is 2.8 hectares, the average yield is 0.138 ± 0.010 kg/ha, the operational reserve is 330.4 kg, the annual harvest volume is 66.8 kg.

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