

# Current state of populations and resource assessment of *Alchemilla* species in Western Stara Planina and Western Sredna Gora Mountains in Bulgaria

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**Abstract.** The genus *Alchemilla* L. (Lady's Mantle) comprises 35 species in Bulgaria, 11 of them are Bulgarian and Balkan endemics. Herba *Alchemillae* is widely used in traditional and official medicine. In Bulgaria, the *Alchemilla* spp. are placed under a special regime of use by setting annual regional quotas according to the Bulgarian legalization. The main goal of the present study (2010–2012) was to record the distribution of *Alchemilla* species and determine their resources outside the protected areas in two floristic regions. Using the tracking method, 19 localities were found and studied in Western Stara Planina Mts and 12 in Mt Western Sredna Gora. The transect method was applied for resource assessment of nine economically used populations: five in the Western Stara Planina Mts and four in Mt Western Sredna Gora. Ecological characterization of the habitats, type of the plant community, and resource and operational stock of the species were established. A significant diversity of *Alchemilla* species was found in the Western Stara Planina Mts (12) and less in Mt Western Sredna Gora (9). Two endangered species were detected for the first time: *Alchemilla achtarowii* (Bulgarian endemic) in Mt Sredna Gora and *Alchemilla cathachnoa* (Balkan endemic) in the Western Stara Planina Mts. It was discovered that the operating reserves of Lady's Mantle in the Western Stara Planina Mts were insignificant. A comparative analysis has shown that resources in the Mt Western Sredna Gora (around Koprivshitsa village) are considerably larger and can be used for commercial purposes.

**Key words:** *Alchemilla* spp., endemics, medicinal plants, protection, resources.

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## Introduction

The genus *Alchemilla* L. comprises 35 species in Bulgaria, four of them are Bulgarian and seven are Balkan endemics (Assenov 1973). According to the Medicinal Plants Act (2000), 31 species are considered medicinal plants. These are mesophilic perennial herbaceous plants of the family *Rosaceae* inhabiting mainly

mountainous terrains above 900 m a.s.l. Many of these species are used in phytotherapy. Herba *Alchemillae* is characterized by astringent, anti-inflammatory, styptic, and epithelium recovery effects (Nikolov 2007). Twelve *Alchemilla* species have conservation status and are listed in the *Red List of Bulgarian vascular plants* (Vitkova 2009), as well as in the *Red Data Book of the Republic of Bulgaria* (Vitkova 2015) as

Critically endangered (four species) and Endangered (eight species). Six species are listed in the Biodiversity Act (2002). The species from genus *Alchemilla* are referred to as *Alchemilla vulgaris* complex in the Medicinal plants Act (2000). They are under a special regime of protection and use. Every year the Ministry of Environment and Water sets the regional quotas for their gathering from natural populations outside of the national parks. There is evidence that protected *Alchemilla* species in Bulgaria are distributed mainly in the national parks (Vitkova 2015)..

The *Alchemilla* species can be found in all high mountains in Bulgaria. They take part in eight types of habitats: D.2.3I Balkanic quaking bogs; E2.252 Meso-Thracian mesophile hay meadows; E2.33 Balkan mountain hay meadows; E4.318 Oro-Moesian mat-grass swards; E4.393 Oro-Moesian [*Poa violcaea*] grasslands; E5.41 Screens or veils of perennial tall herbs lining watercourses; E5.572 Moesian tall-herb communities, and F2.2A2 Balkano-Hellenic dwarf bilberry heaths (Gavrilova 2014). The highest cover of *Alchemilla* species was found in two types of habitats: E.5.41 (25%) and E2.33 (23%). Gavrilova & Vitkova (2010) conducted a research on the distribution and ecological characteristics of the *Alchemilla* species in Western Stara Planina Mts. Six species were located in the studied region and the present types of habitats were described.

As valuable medicinal plants, *Alchemilla* spp. have been the subject of several studies regarding their resources and distribution (Vitkova 1997; Vitkova & al. 2011, 2012, 2013a; Vitkova 2015), cultivation (Vitkova 1996; Vitkova & al. 2013b) and phytochemical content (Vitkova 1996; Nikolova & al. 2012; Trendafilova & al. 2012).

The current survey was conducted during the period 2010–2012 in two floristic subregions – Western Stara Planina [Balkan Range (*Western*)] and Mt Sredna Gora (*Western*). The main aim of the study was mapping out the populations of *Alchemilla* species outside the protected areas, establishing the species composition of *Herba Alchemillae*, and determining the operational stocks and measures for protection of *Alchemilla* species.

## Material and methods

Distribution of the *Alchemilla* species was evaluated by the transect method, which is suitable for subal-

pine terrains, mountain meadows and river valleys. The study has been carried out in two floristic subregions of Stara Planina Mts (*Western*) and Mt Sredna Gora (*Western*).

Western Stara Planina Mts lie between the Belogradchik Pass (in the northwest) and Botevgrad pass (in the southeast). This section is 190 km long, with the highest peak Midzhur (2168 m). The landscape of the region is characterized by steep northern slopes, deep and narrow river valleys, naked rocky massifs, and xerothermic grassland. The studied areas include the Chiprovtsi and Berkovitsa mountain divides. The altitude of the studied areas varies from 900 m to 1800 m (Table 1, Map 1).

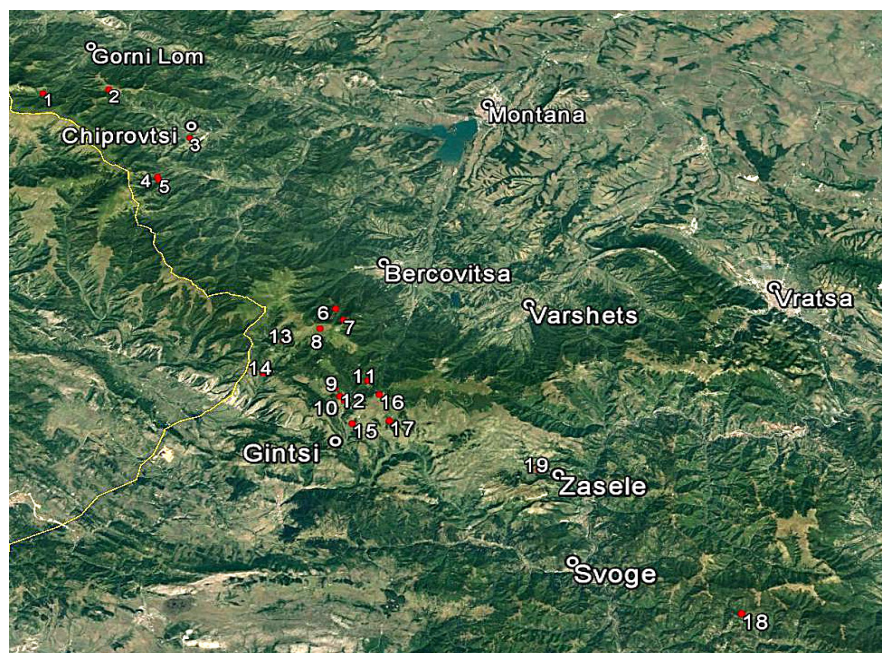
Mt Sredna Gora is the second longest mountain in Bulgaria (above 250 km). This mountain is relatively poor in underground water (Nikolov & Yordanova 1997). Much of the ridges are occupied by mountain pastures which are relatively dry most of the year. The latter is the reason for a limited distribution and a lesser amount of *Alchemilla* species in this mountain. The surveyed regions include Ihtimanska Sredna Gora and part of Sashtinska Sredna Gora in the altitude range from 700 to 1400 m (Table 3, Map 2).

Determination of the taxonomic status of *Alchemilla* species followed Assenov (1973). Determination of the habitat type was according to EUNIS classification (Davies & al. 2004, <http://eunis.eea.europa.eu/>).

The resources of *Alchemilla* species were estimated after Shrëter & al. (1986). This method is based on transects for yield measuring. The entire aerial parts of the plants were collected (flowering stem and leaves). The yield from 1 ha, annual yield and operational stock are given in kg of fresh material. In each of the examined localities the output was defined. The results were processed statistically and the yield calculations followed Supplement 7 to the abovementioned methodology. The operational stock and possible annual yield were determined in plots larger than 0.1 ha of area and with projection cover of *Alchemilla* spp. over 8%, with the exception of a locality in the Western Stara Planina Mts near Kom chalet (Tables 1–4). In that locality the projection cover of Lady's Mantle was 2.5%, but the area exceeded 5 ha, which encouraged us to determine the operational stock. The possible annual yield (70%), as well as the turnover yields (2 years) were determined according to Decree No 2 (2004) on laying down the rules and requirements for collection of herbs and genetic material of medicinal plants.

Table 1. Distribution and resources of *Alchemilla* spp. in Western Stara Planina Mts.

Locality	GPS coordinates	Altitude [m a.s.l.]	Area [ha]	Species	Projection cover [%]	Possible annual yield [kg]
1	2	3	4	5	6	7
Along the trail at the foot of peak Midzhur, 17.06.2010	N 43.420917° E 22.700355°	1013	0.05	<i>A. bulgarica</i>	>0.05	no resources
Mt Yazova, 16.06.2010	N 43.423722° E 22.779167°	1399	50.00	<i>A. serbica</i>	0.05	no resources
1 km SW of Chiprovtsi town, 18.06.2010	N 43.423227° E 22.868948°	574	0.30	<i>A. bulgarica</i>	>0.05	no resources
Above Kopilovtsi village, 15.06.2010	N 43.327417° E 22.856778°	951	20.00	<i>A. bulgarica</i>	>0.05	no resources
Trebish locality in the region of Kopren chalet, 15.06.2010	N 43.324056° E 22.859194°	940	1.00	<i>A. bulgarica</i>	>0.05	no resources
Kom chalet, 14.06.2010	N 43.190056° E 23.080611°	1504	7.00	<i>A. conivens</i> <i>A. subcrenata</i> <i>A. serbica</i>	8.00	36.00
Shtarbanitsa locality at the foot of peak Kom, 14.06.2010	N 43.178000° E 23.091500°	1668	1.00	<i>A. serbica</i>	0.10	no resources
Springs of Nishava river, 17.07.2012	N 43.171371° E 23.070396°	1806	0.05	<i>A. glabra</i> <i>A. monticola</i>	10.00	for personal use
W of Petrohan pass at the foot of peak Chukata, 04.06.2012	N 43.121280° E 23.070448°	1361	25.00	<i>A. glabra</i> <i>A. catachnoa</i>	>1.00	for personal use
Along the stream of river Ginska near Gintsi village, 01.07.2011	N 43.104361° E 23.101583°	1166	0.30	<i>A. obtusa</i> <i>A. viridiflora</i>	15.00	177.00
Meadow 1, N of Gintsi village, 02.07.2011	N 43.109200° E 23.097200°	1217 –1231	0.15	<i>A. obtusa</i> <i>A. glaucescens</i> <i>A. monticola</i> <i>A. glabra</i>	32.80	43.10
Meadow 2, N of Gintsi village, 02.07.2011	N 43.107800° E 23.096400°	1213 –1227	0.20	<i>A. monticola</i> <i>A. bulgarica</i> <i>A. serbica</i> <i>A. glabra</i>	10.65	9.60
Springs of river Kamarska, 06.06.2012	N 43.171371° E 23.070396°	1800	0.08	<i>A. glabra</i>	3.00	for personal use
4 km N of Komshtitsa village, 06.06.2012	N 43.135024° E 23.016271°	1090	0.12	<i>A. bulgarica</i> <i>A. monticola</i>	>2.00	for personal use
Babin krast locality E of Petrohan pass, 05.06.2012	N 43.000996° E 23.119716°	1358	1.70	<i>A. serbica</i> <i>A. glaucescens</i> <i>A. monticoa</i> <i>A. obtusa</i>	>2.50	for personal use
Kaleto locality E of Petrohan pass, 07.06.2012	N 43.108150° E 23.143188°	1442	5.60	<i>A. serbica</i> <i>A. monticola</i> <i>A. viridiflora</i>	2.50	84.67
Golyama chuka locality E of Petrohan pass, 07.06.2012	N 43.100384° E 23.167119°	1371	62.90	<i>A. serbica</i> <i>A. glabra</i> <i>A. obtusa</i> <i>A. reniformis</i>	0.10–0.50	for personal use
Peak Kamarata, 3 km E of Yablanitsa village, 27.09.2010	N 42.851956° E 23.590139°	1094	20.00	<i>A. flabellata</i> <i>A. glaucescens</i>	>0.05	no resources
Between Zasele, Zanoge and Zimevitsa village in the region of peak Zvezdets, 27.09.2010	N 43.044639° E 23.303139°	1071	1.00	<i>A. flabellata</i> <i>A. glaucescens</i>	>0.05	no resources

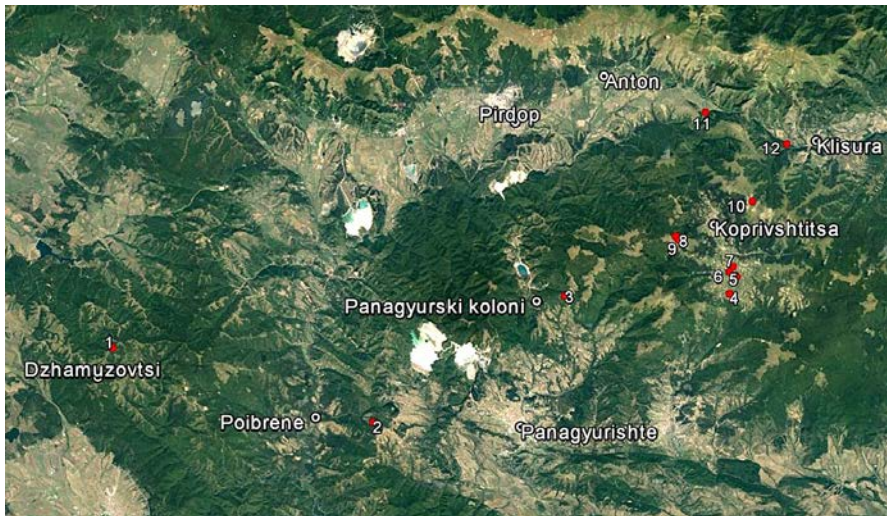


**Map 1.** Localities of *Alchemilla* spp. in the Western Stara Planina Mts (1. The foot of peak Midzhur; 2. Mt Yazova; 3. Trail near Chiprovtsi town; 4. Above Kopilovtsi village; 5. Region of Kopren chalet; 6. Kom chalet; 7. Shtarbanitsa locality; 8. Springs of river Nishava; 9. The foot of peak Chukata; 10. Stream of the river Gintska; 11. Gintsi village (1); 12. Gintsi village (2); 13. Springs of river Kamarska; 14. Near Komshtitsa village; 15. Peak Babin krast; 16. Peak Kaleto; 17. Peak Goliama chuka; 18. Peak Kamarata; 19. The region of peak Zvezdets).

**Table 3.** Distribution and resources of *Alchemilla* spp. in Mt Western Sredna Gora.

Locality	Average GPS coordinates	Altitude [m a.s.l.]	Area [ha]	Species	Projection cover [%]	Possible annual yield [kg]
1	2	3	4	5	6	7
2 km NE of te Dzhamuzovtsi village, 26.05.2010	N 42.548000° E 23.815722°	1052	3.00	<i>A. glaucescens</i> <i>A. gracilis</i>	>0.05	no resources
Near Svezhen chalet, 27.06.2010	N 42.501028° E 24.052222°	895	1.00	<i>A. serbica</i>	>0.05	no resources
Panagyurski Kolonii locality, 28.05.2010	N 42.587917° E 24.224972°	1111	0.30	<i>A. serbica</i>	>0.05	no resources
Sopolivite kamani locality, 4 km S of Koprivshitsa town, 01.06.2011	N 42.59084° E 24.37411°	1097	1.00	<i>A. serbica</i>	2.00	for personal use
3 km SE of Koprivshitsa town, at the foot of peak Orlov kamak, 01.06.2011	N 42.602500° E 24.380600°	1059	1.00	<i>A. subcrenata</i> <i>A. serbica</i> <i>A. glabra</i> <i>A. crinita</i> <i>A. monticola</i>	19.10	75.60
Riverside meadows, 3 km S of Koprivshitsa town, 02.06.2011	N 42.605370° E 24.373970°	1045	10.00	<i>A. crinita</i> <i>A. serbica</i> <i>A. glabra</i>	2.00	for personal use
Paisieva cheshma locality near Koprivshitsa town, 02.06.2011	N 42.609083° E 24.377167°	1062	0.80	<i>A. bulgarica</i>	20.00	for personal use
Southern slopes of peak Malak pop 1, 31.05.2011	N 42.626270° E 24.327019°	1346	0.13	<i>A. glabra</i> <i>A. glaucescens</i> <i>A. monticola</i>	22.50	14.38
Southern slopes of peak Malak pop 2, 31.05.2011	N 42.628530° E 24.324550°	1375	0.50	<i>A. serbica</i> <i>A. glaucescens</i> <i>A. crinita</i>	45.00	61.40
At the foot of peak Belia kamak, 30.05.2011	N 42.652423° E 24.393030°	1307	1.00	<i>A. serbica</i> <i>A. crinita</i> <i>A. bulgarica</i>	31.93	189.00
Near the crossroads N of Koprivshitsa town, 30.05.2010	N 42.711972° E 24.350722°	876	1.00	<i>A. glabra</i> <i>A. achtarovii</i>	0.20 >0.05	for personal use
Along riverside of river Stryama, 1.5 km W of Klisura town, 30.05.2010	N 42.691583° E 24.425167°	756	0.20	<i>A. bulgarica</i> <i>A. crinita</i> <i>A. subcrenata</i>	>0.05	no resources





**Map 2.** Localities of *Alchemilla* spp. in Mt Western Sredna Gora (1. Near Dzhamyuzovtsi village; 2. The region of Svezhen chalet; 3. Panagyurski Kolonii locality; 4. Sopolivite kamani locality; 5. At the foot of peak Orlov kamak; 6. Near Koprivshitsa town; 7. Paisieva cheshma locality; 8. At the foot of peak Malak Pop (1) 9. At the foot of peak Malak Pop (2); 10. At the foot of peak Belia kamak; 11. N of Koprivshitsa town; 12. W of Klisura town).

## Results and discussion

In Stara Planina Mts and Mt Sredna Gora, the species of genus *Alchemilla* mainly grow in the river valleys. These habitats provide the necessary soil and air moisture, which are limiting factors for the development of the species. The survey results show that in both floristic regions the *Alchemilla* species were found in three types of habitats: E.2.33 Balkan mountain hay meadows, with 11 *Alchemilla* species; E5.41 Screens or veils of perennial tall herbs lining watercourses, with 10 species; and D2.3I Balkanic quaking bogs, with three *Alchemilla* spp.

### Western Stara Planina Mts

In the studied regions of Western Stara Planina Mts, 19 localities of *Alchemilla* species were found. Of these, 16 could be assigned to the abovementioned habitat E2.33. The accompanying species were: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Asperula capitata*, *Bistorta major*, *Briza media*, *Carex pallescens*, *Cruciata glabra*, *Deschampsia caespitosa*, *Epilobium angustifolium*, *Festuca pratensis*, *F. rubra*, *Hypericum perforatum*, *Juncus effusus*, *Luzula campestris*, *L. luzuloides*, *Ranunculus acris*, *Rhinanthus rumelicus*, *Senecio nemorensis* s.l., *Trifolium pratense*, etc. Gramineae species predominated in these localities. Their dense cover made the seed and vegetative propagation of *Alchemilla* species very difficult. The spatial structure of the *Alchemilla* species was defined by sufficient moisture and availability of open eroded terrains. A huge part of the localities were remarkable for their vast area reaching nearly hundreds of hectares, while the cover

of species was low (0.05% to 8%, Table 1): Mt Yazova, Kom chalet, Shtarbanitsa locality, Kaletto locality, Kamarata locality. On other occasions, the *Alchemilla* species were represented by single specimens (under peak Midzhur, in the hay meadows around Chiprovtsi town and Zasele village). Three of the localities (the stream of river Ginska and the springs of Nishava and Kamarska rivers) refer to habitat E5.41. These were waterlogged riverside plant communities, including such species as: *Aegopodium podagraria*, *Angelica panicicii*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Briza media*, *Caltha palustris*, *Campanula patula*, *Carex ovalis*, *Centaurea nervosa*, *Cerastium pumilum*, *Cirsium ligulare*, *Chaerophyllum hirsutum*, *Galium palustre*, *Geum coccineum*, *Crepis paludosa*, *Dianthus superbus*, *Epilobium hirsutum*, *Epipactis palustris*, *Eriophorum latifolium*, *Filipendula ulmaria*, *Gentiana asclepiadea*, *Juncus conglomeratus*, *Mentha longifolia*, *Myosotis palustris*, *Potentilla erecta*, *Prunella vulgaris*, *Rumex acetosa*, *Sanguisorba officinalis*, *Scirpus sylvaticus*, *Succisa pratensis*, *Telekia speciosa*, *Trifolium dubium*, *T. hybridum*, *T. pratense*, *Trollius europaeus*, *Tussilago farfara*, *Veratrum lobelianum*, etc. In these localities the *Alchemilla* species were distributed along the waterside of mountain streams, around springs or waterlogged lowerings with an area between 0.05 and 0.3 ha. The cover of the plants along river Ginska was between 10% and 30% and it was significantly higher in comparison to the mountain hay meadows.

In Western Stara Planina Mts, 12 *Alchemilla* species were found: *Alchemilla bulgarica*, *A. catachnoa*, *A. connivens*, *A. flabellata*, *A. glabra*, *A. glaucescens*, *A. monticola*, *A. serbica*, *A. subcrenata*,

*A. obtusa*, *A. reniformis*, and *A. viridiflora* (Table 1). The most common were: *Alchemilla serbica* (17%), *A. monticola* (15%), *A. glabra*, *A. bulgarica* (14%), and *A. glaucescens* (10%) (Fig. 1). It is worth mentioning that within the limits of one locality a few *Alchemilla* species could be found.

Operational stocks of five localities were defined (Table 2). The data shows that the quantity of plant material of the *Alchemilla* species in these localities was limited, but could be used for personal as well as commercial purposes. The operational stock was measured between 13.72 kg and 253.4 kg of fresh material. The possible annual yield varied between 9.6 to 177.4 kg of fresh material in the separate localities. The total annual production of the five localities was 350 kg. The results of the study show that the region is

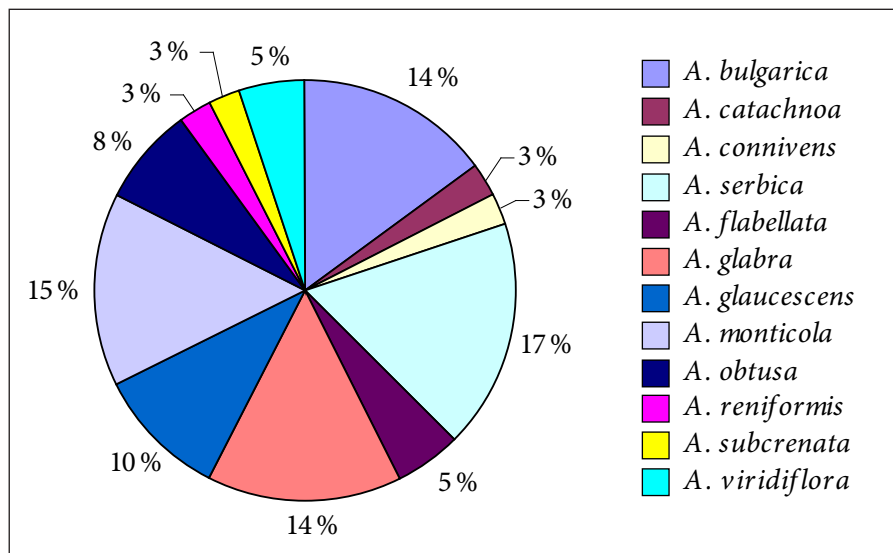
characterized by a relatively low operational stock of *Alchemilla* spp.

### Western Sredna Gora

In the studied regions of Mt Sredna Gora, 12 localities of nine *Alchemilla* species were found: *Alchemilla ahtarowii*, *A. bulgarica*, *A. crinita*, *A. glabra*, *A. glaucescens*, *A. gracilis*, *A. monticola*, *A. serbica*, and *A. subcrenata* (Table 3). Approximately one to five species could be found in just one locality. The most common species were: *Alchemilla serbica* (29%), *A. crinita* (17%) and *A. glabra* (14%) (Fig. 2). The studied territories were mainly humid hay meadows (E2.33) and riverside communities (D 2.31). The area of the localities was between 0.13 ha to 10 ha (Table 3). The cover of *Achemilla* species in the studied locations varied widely between

**Table 2.** Resource assessment of *Alchemilla* spp. in Western Stara Planina Mts.

Locality	Species	Average projective cover [%]	Area [ha]	Yield [kg/h]	Operational stocks [kg]	Yield/ Output	Possible annual yield [kg]
Kom chalet, 14.06.2010	<i>A. serbica</i>	8.00	7.00	7.40 ±2.30	51.40 ±15.91	4.00	36.00 ±11.16
along the stream of river Ginska, 01.07.2011	<i>A. obtusa</i> <i>A. viridiflora</i>	15.00	0.30	844.80 ±59.10	253.40 ±17.74	4.00	177.40 ±12.40
meadow 1, N of Gintsi village, 02.07.2011	<i>A. monticola</i> <i>A. glabra</i> <i>A. obtusa</i> <i>A. glaucescens</i>	32.80	0.15	410.00 ±39.77	61.50 ±6.00	4.70	43.05 ±4.20
meadow 2, N of Gintsi village, 02.07.2011	<i>A. monticola</i> <i>A. glabra</i> <i>A. serbica</i> <i>A. bulgarica</i>	10.65	0.20	68.60 ±16.80	13.72 ±3.42	4.20	9.60 ±2.41
Kaleto locality, 07.06.2012	<i>A. monticola</i>	2.50	5.60	21.62 ±6.20	120.96 ±34.59	3.50	84.67 ±24.22



**Fig. 1.** Percentage contribution of *Alchemilla* spp. in Western Stara Planina Mts.

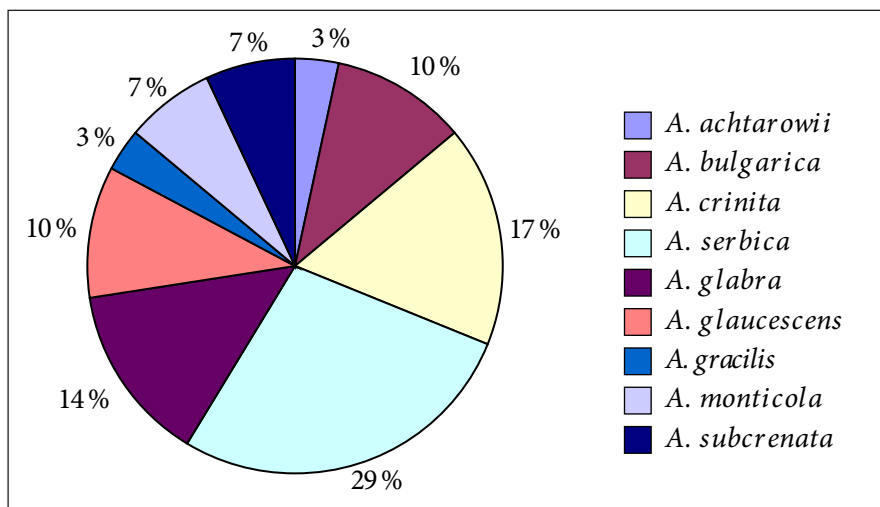


Fig. 2. Percentage contribution of *Alchemilla* spp. in Mt Western Sredna Gora.

Table 4. Resource assessment of *Alchemilla* spp. in Mt Western Sredna Gora.

Locality	Species	Average projective cover [%]	Area [ha]	Yield [kg/h]	Operational stocks [kg]	Yield/ Output	Possible annual yield [kg]
peak Orlov kamak, 01.06.2011	<i>A. monticola</i>	19.10	1.00	108.00 ±6.80	108.00 ±6.80	5.10	75.60 ±8.33
	<i>A. serbica</i>						
	<i>A. subcrenata</i>						
	<i>A. crinita</i>						
	<i>A. glabra</i>						
Malak pop 1, 31.05.2011	<i>A. monticola</i>	22.50	0.13	158.00 ±17.61	20.54 ±2.29	4.90	14.38 ±1.60
	<i>A. glabra</i>						
	<i>A. glaucescens</i>						
Malak Pop 2, 31.05.2011	<i>A. crinita</i>	45.00	0.50	175.43 ±45.74	87.70 ±22.87	5.50	61.40 ±16.03
	<i>A. glaucescens</i>						
	<i>A. serbica</i>						
peak Belia Kamak, 30.05.2011	<i>A. crinita</i>	31.93	1.00	270.05 ±40.23	270.05 ±40.23	4.90	189.00 ±28.16
	<i>A. bulgarica</i>						
	<i>A. serbica</i>						

0.2% and 45%. Mention deserves the fact that a high cover of *Alchemilla* species was reported in some limited areas, mainly in the region of river Chumina near Koprivshtitsa town. The available resources in most localities were small and could be used for personal needs only. A more significant operational stock with a greater economic value was found in the region of Koprivshtitsa town (along the riverside of Chumina and Pop-ska rivers). These were wetlands with an altitude of over 1000 m and an area of localities up to 10 ha. The operational stock and the possible annual yield were established in four localities. (Table 4)

The locality below peak Orlov kamak was situated about 3 km to the southeast of Koprivshtitsa town, on a southwestern slope inclined 12–15° and with an area of 1 ha. It could be assigned to habitat E2.33. Five *Alchemilla* species were found there (*A. glabra*, *A. crinita*, *A. monticola*, *A. serbica* and *A. subcrenata*), with an average projective cover of the species of 19%. The

*Alchemilla* species were irregularly distributed. In some patches, the cover of the species varied between 3% and 15%, while in others it reached 60–70%. In spite of the irregular distribution of the species, the operational stocks showed that the population could be used for gathering. The accompanying species were: *Carex echinata*, *Cirsium ligulare*, *Cruciata glabra*, *Festuca pratensis*, *F. nigrescens*, *Galium verum*, *Geum rhodopeum*, *Hypericum perforatum*, *Hypochaeris maculata*, *Leucanthemum vulgare*, *Luzula luzuloides*, *Rumex acetosa*, *Rhinanthus rumelicus*, *Veronica chamaedrys*, *Viola dacica*, etc. The operational stock of the locality was determined at 108 kg, while the possible annual yield was 75.60 kg of fresh material.

The locality below peak Beliya Kamak was situated about 3 km to the northeast of Koprivshtitsa town. The locality of *Alchemilla* species was situated in mountain meadows truncated by a tributary of Chumina and Dalga rivers, both flowing into river Stryama.

These were wet places which could be referred to habitat D2.31. Under snow melting processes or plentiful rains they got flooded because the existing streams failed to absorb the entire water flow. The population covered an area of 1 ha on a slope with 1–5° incline of southeast exposition. Three *Alchemilla* species were found at this locality (*A. crinita*, *A. bulgarica* and *A. serbica*) with an average plant cover of about 32%. In some places, the average plant cover reached 50–60%. The other species identified in this locality were: *Caltha palustris*, *Carex* sp., *Dactylorhiza cordigera*, *Eriophorum angustifolium*, *Geum rhodopeum*, *Pinguicula balcanica*, *Potentilla erecta*, *Sphagnum* spp., etc. In 2010, the region was overtaken by fire which negatively affected the locality of *Alchemilla* species. Fast succession processes could be observed and balance is expected to be reached in the near future.

The locality below peak Malak pop was formed by two fragments which could be assigned to habitat E2.33. One of them was located at the foot of the southern slope of the peak with inclination of 11–15°, along a tributary of river Popska. The area of the locality was 0.13 ha, the average cover of *Alchemilla* species was 22%. Three *Alchemilla* species were found – *A. glaucescens*, *A. glabra* and *A. monticola*. The accompanying species of *Alchemilla* were: *Anthoxanthum odoratum*, *Caltha palustris*, *Carex hirta*, *Cardamine glauca*, *Cruciata glabra*, *Dactylorhiza cordigera*, *Eriophorum latifolium*, *Festuca pratensis*, *Luzula luzuloides*, *Rhinantus rumelicus*, etc. The second fragment was in a wet hay meadow with an area of 0.5 ha and southern exposition on a slope of 6–10° incline. Three *Alchemilla* species were found there (*A. crinita*, *A. glaucescens* and *A. serbica*). The other identified species were: *Cardamine glauca*, *Carex hirta*, *Cerastium arvense*, *Chamaespartium sagittale*, *Eriophorum latifolium*, *Euphrasia pectinata*, *Festuca pratensis*, *Hieracium cymosum*, *Juniperus communis*, *Luzula campestris*, *Nardus stricta*, *Rumex acetosa*, *Scleranthus perennis*, *Thymus* sp., *Veronica serpyllifolia*, etc.

In the investigated areas, there were found three species with conservation status: 1. *Alchemilla achtarovii* – Bulgarian endemic, included in 1997 IUCN Red list of threatened plants as Rare and in the Red data book of the Republic of Bulgaria as Endangered (Vitkova 2015), listed under Biodiversity Act in annex 3; 2. *Geum rhodopeum* included in the Red list of Bulgarian vascular plants as Near threatened (Apostolova 2009); 3. *Dactylorhiza cordigera* listed under the Biodiversity Act in annex 4

and covered by the Convention on international trade in endangered species of wild fauna and flora (CITES). Additionally, *Pinguicula balcanica* which is a Balkan endemic has been recorded too.

## Conclusion

A study of the distribution of species of genus *Alchemilla* and their operational stocks was carried out outside the protected territories of Western Stara Planina Mts and Mt Western Sredna Gora. In the studied regions of Western Stara Planina, 12 *Alchemilla* species were found, two of them were Balkan endemics (*Alchemilla catachnoa*, *A. viridiflora*). In Western Sredna Gora, nine *Alchemilla* species were found, one of which was a Bulgarian endemic (*A. achtarovii*). *Alchemilla achtarovii* and *A. catachnoa* are included in the Red data book of R Bulgaria in the category Endangered. The most common *Alchemilla* species in the studied regions of the two mountains were: *A. glabra*, *A. crinita*, *A. monticola*, and *A. serbica*. In Western Stara Planina, the species *Alchemilla connivens*, *A. reniformis*, *A. viridiflora*, and *A. obtusa* were found for the first time. In Western Sredna Gora, *A. serbica* and *A. viridiflora* were located for the first time.

Economically significant localities of *Alchemilla* species could be found mainly in three types of habitats: E2.33 Balkan mountain hay meadows, E5.41 Screens or veils of perennial tall herbs lining watercourses and D2.3I Balkanic quaking bogs. The operational stocks were significantly higher in the investigated localities of Western Sredna Gora.

The average projective cover of the *Alchemilla* species in the localities of Western Stara Planina Mts varied between 0.05% and 32.80%, while in Mt Western Sredna Gora it was between 0.2% and 45%. The estimated operational stock in the studied regions in each of the two mountains was around 500 kg of fresh aerial parts of the plants.

The study has shown that in the regions of Western Stara Planina Mts and Mt Western Sredna Gora the resources of *Alchemilla* species are limited and could be gathered chiefly for personal needs applying the principles of yield turnover and rotation of the localities during their exploitation. When gathering plant material, it is necessary to avoid the regions with the Balkan endemics *A. catachnoa* and *A. viridiflora* (Petrohan Pass) and the Bulgarian endemic *A. achtarovii*



(near Koprivshitsa town). While gathering *Herba Alchemillae*, it is necessary to observe the provisions of the Decree No 2 (2004) laying down the rules and requirements for collection of herbs and genetic material of medicinal plants, which provides the permissible amount of gathering and the periods for regeneration of the resources.

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