

***Krascheninnikovia ceratoides* (L.) Gueldenst. a presumable Weichselian relic species, in the Flora of the Transylvanian Basin**

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Introduction

The distribution of the genus *Krascheninnikovia* Gueldenst.¹(=*Ceratoides* Gagnebin, *Eurotia* Adanson nom. illegit.) is circumpolar with large disjunctions, following the discontinuities of the main habitat of the species – the dry steppes.

The number of species considered by different authors varies between three (MOSYAKIN 2000) and seven (ILJIN 1936). A single species, *Krascheninnikovia lanata* (L.) Gueldenst. lives in the Nearctic (western and southern parts). There are three largely recognized species in the Palearctic, *Krascheninnikovia ceratoides* (L.) Gueldenst., with the widest range (anatolo-armeno-irano-turanian and mongolian-tibetan-himalayan element with isolated relic populations westwards and eastwards) *Krascheninnikovia ewersmanniana* (Stschegl. ex Losinsk.) Grubov (more xerophilous turano-west mongolian-uygur element) and *Krascheninnikovia compacta* (Losinsk.) Grubov (= *K. arborescens* Losinsk.) from northern Tibet.

All the species of *Krascheninnikovia* inhabit dry cold steppes, which are their main type of habitat. In other more humid and / or warmer areas of the Holarctic the species are sometimes represented by few populations that are believed to be glacial relics.

Due to these ecological characteristics, the small relic localities of *Krascheninnikovia ceratoides* in Central Europe are thought to be vestiges of the last glacial period the Weichselian (=Würm) when cold dry steppes of a periglacial type largely occurred in the region (ROBERTS 1993, WALTER 1985, BELL & WALKER 1998). However, this hypothesis has to be proven by further molecular clock and eventually by more detailed palinological investigations

In Central Europe there were only three known localities of this species, two in the Pannonian forest-steppe area (Weinviertel, in Eastern Austria, and Nagyhöröcsökpuszta in Central Hungary – at the latter place the species has disappeared, FARKAS 1999) and one in the Transylvanian Basin (Vultureni – Borsajfalu) that curiously stands rather far from the Transylvanian forest-steppe area. To this list we add here a new locality in the Transylvanian forest-steppe of the Transylvanian Lowland („Câmpia Transilvaniei”, „Erdélyi Mezőség”), where this plant had been expected to be found for a long time (for a concise presentation of the region see NIEDERMAIER, 1973). With this new discovery the number of the Central European localities rises to four.

The localities of *Krascheninnikovia ceratoides* (L.) Gueldenst. in the Transylvanian Basin

1. Vultureni (= Borsajfalu) on the western and southern slopes of „Dealul Mare” (= „Nagydomb”) Hill, Cluj county, FT 90 (UTM biocartographic code).

This is the location in the Transylvanian Basin, where the species was discovered by SOÓ (1945). After the discovery, the site was visited only by two other botanists, D. PÁZMÁNYI in 1963 and Gh. GROZA in 2000 (after the materials in the two main herbaria in Cluj Napoca / Kolozsvár - of the Babeș – Bolyai and

¹ We must underline that there exists another genus bearing almost the same name – with the difference of one letter, “W” instead of “V” - *Krascheninnikowia* Turcz. in *Caryophyllaceae* with many nemoral species in the eastern Palearctic and one relic in Europe. Due to the fact that Turczaninov described his genus much later (1842) than Gueldenstaedt (1773) the latter’s generic name have priority, while *Krascheninnikowia* was renamed *Pseudostellaria* Pax. (This is necessary to be said cause there are many published lists with species from the both genera and this can mislead someone in regarding the number of the species in *Krascheninnikovia* Gueldenst.)

Agricultural Universities).

The site is located 12 km north of the north-western limit of the Transylvanian forest steppe area (Fânațele Clujului = Kolozsvári Szénafüvek) and 20 km west of the border of Erdélyi Mezőség. The climate of this region is very humid with annual precipitation around 700 mm. Due to the macroclimatic conditions, this site is an extremely curious one, because it stands out of the surrounding nemoral forests of durmast oak (*Quercus petraea*) and hornbeam (*Carpinus betulus*) as a very small xerophilous, almost semidesert-like, and completely isolated island habitat. The dominant plant is the xerophilous crested wheat *Agropyron cristatum* subsp. *pectinatum* which, together with *Krascheninnikovia ceratoides*, gives the aspect of a semidesert landscape.

In the rest of the Transylvanian Basin, the associations dominated by *Agropyron cristatum* subsp. *pectinatum* occur mostly in the southern part of the Transylvanian Lowland (Erdélyi Mezőség), where the average annual precipitation is under 550mm (see MAN 2000), and where they are confined to the upper part of the sunny, dry slopes. This is the area where the new Transylvanian locality of *Krascheninnikovia* is found.

The population size of *Krascheninnikovia* at Vultureni exceeds 1000 individuals. The plants are concentrated at the base of the slope in a phytocenosis dominated by *Agropyron cristatum* subsp. *pectinatum*, and on the fresh outcrops left by the active landslides where *Krascheninnikovia* is a pioneer. Here most of the individuals are at least 1 m high and very vigorous. Less developed individuals are scattered around the rest of the area, in phytocenoses dominated by *Stipa pulcherrima*, *Carex humilis* and *Festuca rupicola*.

It is noteworthy that the Romanian botanical literature erroneously indicates “Borșa” as the locality of this population. The authors (MORARIU 1952, CIOCĂRLAN 2000 etc.) were confused by the Romanian and Hungarian names of the two neighboring villages, Borșa = Kolozsborsa / Vultureni = Borsaujfalu, and they have mistaken Vultureni for Borșa.

The administrative center of the territory is Vultureni (the site stands to the north immediately above the center of the village).

2. Răzoare (= Mezövelkér) - Șăulia (= Mezösályi) at Groapa Rădăii² on „Coasta lui Orban” (= “Orbándomb”), on the southern half of the sunny slope, 380–400 m, Mureș county, UTM KM 86.

While investigating the xeric vegetation in the Miheșu de Câmpie (Mezöméhes) – Șăulia (Mezösályi) area in the central, most arid part of the Transylvanian Lowland in 1999, AL. S. BĂDĂRĂU and Gh. COLDEA discovered a new isolated population of this species. The locality was checked by the Hungarian botanists MOLNÁR V. Attila and LENDVAI Gábor in 2001. Here the population is not as large as that at Vultureni; it does not exceed two hundred individuals. They occur in the same ecological and phytocenological conditions as at the first locality with the difference that there are no large groups of vigorous individuals at the base of the slope. This can be attributed to the grazing pressure from sheep that is stronger here than at Vultureni.

The territory belongs to Miheșu de Câmpie / Mezöméhes county.

Some ecological features of the Transylvanian localities of *Krascheninnikovia ceratoides*

When comparing the two Transylvanian sites, it becomes obvious that the following particular ecological conditions are shared by them:

1. In both sites *Krascheninnikovia ceratoides* occurs on steep, sunny, and very dry slopes that ensured the continuity of the landsliding processes from the late Quaternary, very likely as early as the Weichselian period. Indeed, both slopes have unusually large undulated glacises at their basal part that are continuously supplied with colluvial materials carried by the active, ceaseless landslides. This situation seems to be uncommon among the slopes in the Transylvanian Basin, *and in our opinion has been essential for the preservation of this species here*. The continual landslides on these slopes ensured the *uninterrupted occurrence* of large barren sand and marl outcrops that are the main habitats of *Krascheninnikovia* which, like all dry steppe plants, cannot stand the concurrence conditions and therefore cannot live in closed steppe grasslands. In a metapopulation context, groups of plants on these barren sites serve as the main “source” for the entire population, because they contain the most vigorous individuals which produce the largest quantity of seeds.

² On the older maps from the XIXth century the place is named “Groapa Rațelului” and on the ones from the XVIIIth century „Groapa Ratscii”. These in old Romanian mean “The Drake’s Hole” and “The Duck’s Hole” respectively in relation to the rich avifauna on the lake nearby. The actual official Romanian name, „Groapa Rădăii” have no meaning. We have also to say that there are two groups of houses with this name placed in two different neighboring valleys. We refer here to the southern group.

A large part of these slopes is covered by dry steppe like phytocenoses dominated by the crested wheat *Agropyron cristatum* subsp. *pectinatum*. It is interesting to notice that also in the dry steppes of Central Asia *Krascheninnikovia* is found in most cases in phytocenoses dominated by the same grass species (e.g. ARIFHANOVA 1967, KARAMYSHEVA & KHRAMTSOV 1995). Another species frequently associated with *Agropyron cristatum* and *Krascheninnikovia ceratoides* in the dry steppes of Asia is *Kochia prostrata* L.³. In Central Europe the extrazonal dry steppe-like association dominated by *Agropyron cristatum* subsp. *pectinatum* is known as *Agropyro – Kochietum prostratae* Zólyomi (1957) 1958. In the Transylvanian dry steppe phytocenoses, *Kochia prostrata* is rather rare and is actually missing from the two particular sites where *Krascheninnikovia ceratoides* occurs. Nevertheless, in our opinion, their similarities in the ecological conditions and species composition to those of *Agropyro-Kochietum prostratae* justify their inclusion in this association. These phytocenoses in Transylvania seem to have a greater resistance to sheep overgrazing than the *Stipa* dominated steppe – like grasslands (*Stipetum lessingiana* Soó (1927) 1946, *Stipetum pulcherrimae* 1946 Soó) based on the changes in their species composition when exposed to similar levels of grazing.

However, this resistance is not unlimited and over time *Agropyron cristatum* subsp. *pectinatum* is slowly replaced by grass species that are even more resistant to human disturbance, like *Agropyron intermedium*, *Stipa capillata*, *Andropogon ischaemum*. The initial composition of the phytocenoses is also completely altered by the invasion of ruderal species. Such an alteration was observed in both Transylvanian sites of *Krascheninnikovia* where there are many invading ruderal species (see Table 1) while genuine steppe species disappeared, like *Serratula radiata*, *Peucedanum tauricum*, *Crambe tataria*, *Echium rossicum*, *Dictamnus albus*, *Salvia nutans*. These are normally common in the steppe – like grasslands of Transylvania but are also very sensitive to overgrazing. The newly discovered locality at Groapa Rădăii is critically endangered due to the reduced number of individuals which remained in the population and which seems to be the subject of a continual decrease caused by overgrazing.

Taxonomical considerations

It is very interesting that the two Transylvanian populations exhibit conspicuous morphological differences. Following ILJIN (1936), all the individuals at Vultureni can be classified as forma *angustifolia* Fenzl. with *mature* leaves 3-4 mm wide, whilst all the individuals at Groapa Rădăii belong to forma *latifolia* Miq. with 6-8 mm wide *mature* leaves. In our opinion, this difference may have a genetic basis, and can be the result of genetic drift and / or bottleneck. In the large populations from the dry steppes of easternmost Europe and Asia the two forms occur together (ILJIN 1936). A comparative genetic study of the two populations as well as a comparison between them and other populations from all over the Palearctis would help to better understand the genetic processes which take place in small populations (of long - lived species) isolated for a long time. Also this would serve to a more accurate identification of the moment when this species entered the Transylvanian Basin, by using molecular clock techniques.

Összefoglalás

A *Krascheninnikovia ceratoides* (L.) Guldens, egy periglaciális sztyepp reliktumfaj Erdély flórájában
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A *Krascheninnikovia ceratoides* (L.) Guldens a Palearktisz nyugati felében egy weichseli glaciális reliktumfaj. Ez a növényfaj az utolsó jégkorszak idején benépesítette az európai periglaciális sztyeppét és erdőssztyeppét. A palearktisz nyugati felében még megmaradt néhány reliktum populáció, mint az észak-pontusi sztyeppéken, a kárpát-medencei elszigetelt erdőssztyeppéken, valamint Dél-Spanyolország, Algéria és Marokkó mediterrán sztyeppéin. Az Erdélyi-medencében csupán egyetlen lelőhelye volt ismert, mégpedig Borsajúfalva mellett, melyet Soó Rezső fedezett fel 1943-ban. A 1999-es évben felfedeztünk egy újabb *Krascheninnikovia ceratoides* lelőhelyet az erdélyi erdőssztyeppén, a Mezőség déli részében Mezósályi mellett. A borsajúfalvai élőhely makroklímájában gyökeresen eltér az újonnan felfedezett termőhelytől, amely az Erdélyi-medence legszárazabb déli felében található, ahol az évi csapadék mennyisége nem haladja meg az 550 mm-t. Ennek ellenére a két termőhely számos tekintetben igen hasonló. Mindkettő délies kiettségű, meredek suvadásos domboldalon található, márgás alapkőzeten. A suvadások a lejtőalj geomorfológiája alapján igen régóta, feltehetőleg a Weichseli glaciális óta folyamatosak, ami állandó utánpótlást nyújt a

³ Even in the desert steppes of the Nearctis the related species, *Krascheninnikovia lanata*, is frequently associated with *Kochia americana* and *K. californica* that are both closely related to *Kochia prostrata* (they probably should be considered only as subspecies of the latter – MOSYAKIN 2000).

suvasodások létrehozta csupasz márgás felszín számára. Ez az a élőhelytípus, ami biztosíthatta a faj fennmaradását mindkét helyen.

A termőhelyek vegetációjára jellemző az *Agropyron cristatum* dominanciája, amely egy száraz sztyeppe – félsivatagi képet kölcsönöz mindkét területnek. Bár a *Kochia prostata* nem fordul elő egyik helyen sem, a cönológiai felvételek (1. táblázat) tanúsága szerint a növényzet az *Agropyro-Kochietum prostratae* Zólyomi (1957) 1958 társulásba sorolható fajösszetétele, fenetikai és ökológiai jellemzői alapján.

A két populáció egyedei a levelek morfológiájában jelentősen eltérnek. A borsajfalui növények levelei mindössze 3–4 mm szélesek (forma *angustifolia* Fenzl.), míg az új lelőhelyen az egyedek levelei jóval szélesebbek (6–8 mm; forma *latifolia* Miq.). Valószínű, hogy e különbségek eredete genetikai, aminek további vizsgálata fontos lenne.

A Mezősályi melletti új termőhely a borsajfaluinál jóval veszélyeztetettebbnek tűnik a viszonylag kis populációméret (kb. 200 egyed), és a sokkal intenzívebb juhlegeltetés miatt.

Table 1. *Agropyron pectinati* – *Kochietum prostratae* Zólyomi
Relevés from Transylvania containing *Krascheninnikovia ceratoides*

Species	Releve					
	1.	2.	3.	4.	5.	6.
<i>Agropyron pectinatum</i>	3	2	3	2	2	2
<i>Krascheninnikovia ceratoides</i>	1	2	1	2	+	+
<i>Carex humilis</i>					+	
<i>Festuca rupicola</i>	1	+	1	+	1	+
<i>Euphorbia cyparissias</i>	+		+	+	+	+
<i>Artemisia campestre</i>	+	+	+		+	
<i>Salvia nemorosa</i>	1	+		+		
<i>Verbascum phoeniceum</i>	+	+				
<i>Poa angustifolia</i>	+					
<i>Dorycnium herbaceum</i>	+					
<i>Stipa capillata</i>	+	+		+	1	+
<i>Astragalus onobrychis</i>	+			+		+
<i>Teucrium chamaedrys</i>	1	+		+		
<i>Silene donetzica</i>	+					
<i>Achillea millefolium</i>	+					
<i>Tragopogon dubius</i>	+					+
<i>Salvia nutans</i>	+					
<i>Centaurea micranthos</i>	+				+	+
<i>Crataegus monogyna</i>	+	+				
<i>Stachys recta</i>	+	+	+	+		
<i>Convolvulus arvensis</i>		+			+	
<i>Galium verum</i>		+				
<i>Salvia verticillata</i>		+	+			
<i>Agropyron intermedium</i>		+				
<i>Oxytropis pilosa</i>		+	+			
<i>Agrimonia eupatoria</i>		+	+	+		
<i>Veronica spicata</i>		+	+	+		
<i>Potentilla arenaria</i>		+		+	+	+
<i>Medicago falcata</i>		+	+			+
<i>Odontites serotina</i>		+				
<i>Hypericum perforatum</i>		+				
<i>Ballota nigra</i>		+		+		
<i>Thymus glabrescens</i>		+		+	+	+
<i>Plantago lanceolata</i>		+			+	
<i>Melilotus officinalis</i>		+		+		

Table 1. Cont.

Species	Releve					
	1.	2.	3.	4.	5.	6.
<i>Asperula cynanchica</i>		+		+	+	
<i>Andropogon ischaemum</i>		+	+	1	2	1
<i>Solidago virgaurea</i>			+			
<i>Sisymbrium polymorphum</i>			+			
<i>Veronica teucrium</i>			+			
<i>Cleistogenes serotina</i>				1		
<i>Allium fuscum</i>				+		
<i>Astragalus monspessulanus</i>				+	+	+
<i>Plantago media</i>				+		
<i>Asparagus officinalis</i>				+		
<i>Jurinea mollis</i>		+		+		
<i>Artemisia pontica</i>				+		
<i>Phragmites communis</i>				+		
<i>Artemisia vulgaris</i>				+		
<i>Medicago minima</i>				+		
<i>Euphorbia seguierana min.</i>					+	
<i>Koeleria glauca</i>					+	+
<i>Brachypodium pinnatum</i>						+
<i>Astragalus austriacus</i>						+
<i>Leontodon asper</i>						+
<i>Cichorium intybus</i>						+
<i>Sideritis montana</i>						+
<i>Nigella arvensis</i>						+

Place and date of the relevés: 1. Vultureni (Borsaújfalu) on Dealu Mare hill, SE, 60 degrees inclination, 70% coverage, 460m, 50 sq. metr. 3. VII. 2001, Al. S. Badarau. 2. Vultureni on Dealu Mare hill, SE, 50 degr. 90%, 435m, 100 sq. metr. 1. VIII. 2001, Gh. Groza, Al. S. Bădărău. 3. Vultureni on Dealu Mare hill, SE, 45 degr., 65%, 470m, 100 sq. metr. 1. VIII. 2001, Gh. Groza, Al. S. Bădărău. 4. Vultureni on Dealu Mare hill, ESE, 45 degr. 65%, 490m, 100 sq. metr. 1. VIII. 2001, Gh. Groza, Al. S. Bădărău. 5. Groapa Rădăii on "Coasta lui Orban" SW, 40 degr. 75%, 345m, 200 sq. metr. 1. VIII. 2001, Al. S. Bădărău, Gh. Groza. 6. Groapa Rădăii on "Coasta lui Orban" SW, 35 degr. 65%, 350m, 100sq. metr. 1. VIII. 2001, Al. S. Bădărău, Gh. Groza.

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