

**PRELIMINARY DATA ABOUT THE CHOROLOGY OF THE SPECIES
JOVIBARBA HEUFFELII (SCHOTT) A. LÖVE & D. LÖVE
(CRASSULACEAE) IN SOUTHERN CARPATHIAN MOUNTAINS
IN ROMANIA**

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Abstract: *Jovibarba heuffelii* (Schott) A. Löve & D. Löve is a perennial monocarpic crassulacean, having hexamerous flowers, with yellow(ish) petals and ciliated leaves, glabrescent or glandular hairy on both sides.

The species is a characteristic carpato-balkan (dacia) element, with a range spanning between 18°E-27°E meridians. In Romania it is distributed throughout the country, showing wide ecological amplitude, the species inhabiting preponderantly dryer habitats in higher rocky locations.

The region involved in our study spans North of Danube being limited approximately by the 46°N parallel to the North, comprising a wide variety of habitats from the Danube flood plains to the highest peaks in the Romanian Carpathian Mountains (an altitude ranging between n 50-2550m s.m.), with a climate and edaphic conditions similarly diverse.

Our study presents a more precise distribution list of the locations from which *Jovibarba heuffelii* was mentioned and a grid map in the UTM projection system of the species distribution in Southern Carpathian Mountains, together with some chorological and ecological considerations with regard to biotic and abiotic factors involved in its distribution.

Background

Jovibarba heuffelii is a crassulacean described and dedicated by Schott in 1853 to Johan Heuffel (1800-1857), a botanist well acquainted to southern Carpathian flora. It is a monocarpic perennial blooming only after several years of vegetation. A hardy xerophyte, it tolerates well large variations of temperature, humidity and insolation, due to special metabolic and morphologic adaptations to save and store water in their succulent mesophyll. As its special vacuolar and metabolic apparatus can minimize O₂ toxic effects on tissues, this plant is not required to open the stomata during photosynthesis. This adaptation allows it to continue photosynthetic CO₂ fixation even in the absence of liquid water sources.

Its soil requirements add to this plants considerable ecological amplitude, matched only by its vegetative prolificacy. Like all other *Sempervivum* s.l., *Jovibarba heuffelii* is also a long-lived perennial distinctive from the rest by propagating via caulinar pseudo-dichotomic ramification as opposed to stolon propagation in all other *Semperviva*. The promiscuity observed amongst the other *Sempervivum* s.l. species appears to lack in the case of *Jovibarba heuffelii*, which in populations highly mixed with *S. marmoreum* showed not a single hybrid.

The high geographical isolation limits severely the gene flow between *Jovibarba heuffelii* populations which consist of relatively compact clones.

In other species from *Sempervivum* s.l. the populations have evolved gradients of characters in conspecific adjacent clonal populations, making positive identification of taxa at least challenging. Despite this widely spread characteristic of *Sempervivum* s.l., *J. heuffelii* is a rather distinct taxon, easily distinguishable from the other due to its characteristic lack of stolons replaced by propagation through apical division and its hexameric campaniform corolla with

nonfimbriated yellow(ish) petals. Another conspicuous character is the dimension of mature rosettes that are many folds larger than the flowers, distinguishing at a glance typical *Jovibarba heuffelii* plants from the other *Jovibarba* taxa.

Taxonomically, at supraspecific level, *J. heuffelii* had a rather ambiguous and disputed status, being alternatively attributed to either the independent valid *Jovibarba* (or *Diopogon*) genus or a taxon of infrageneric rank subordinated to *Sempervivum* s.l. At present, according to *Atlas Florae Europaeae* [15] it belongs to the valid genus *Jovibarba* Opiz. At specific level, despite the continual variation of some of its characters like leaf pubescence, colour and shape; petal colour and shape, etc, *J. heuffelii* (Schott) A&D Löve is a rather well circumscribed species, although having several disputed and ill defined infraspecific components.

Phylogenetically and systematically, *Jovibarba heuffelii* is related closest to the nebulous *J. globifera/hirta/arenaria/allioni* complex and then to the rest of *Sempervivum* s.l. taxa.

From an ecological standpoint, *J. heuffelii* typically is a thermophylous xerophyte, and usually a calcicolous saxicolous-chasmophylous orophyte. It builds cushion-like conglomerations of densely packed rosettes of clonal vegetative descent, taking advantage of every crevasse or asperity of sheer rock walls. In Romania it typically prefers fertile soils like calcicolous rendzina on well-drained exposed limestones, although it shows considerable ecological amplitude. Its altitudinal range spans from virtually sea level to over 2000m s.m.

From a phyto-geographical and chorological point of view, *J. heuffelii* is a characteristic carpatho-balkan (dacian) floristic element, with a European range spanning between 18°E and 27°E meridians. Its native range is confined to the mountains of the northern Greek peninsula, the Balkans and the southern part of the Carpathian mountain chain. Together with the Balkans, the Carpathians might have very well been a speciation center in *Sedum*, as t'Hart work suggests [13], and probably contributed to the speciation of *Jovibarba* and *Sempervivum* as well.

Based on the classification of Meusel et al [21], Stevanovic in his analysis of the orophytic elements on the mountains of the Balkan Peninsula [32] specifically designates *Jovibarba heuffelii* as a central (S) European orophyte, due to its prevailing occurrence (besides the Carpathian mountains) in Balkan, Dinaric, Scardo-Pindic and Balkan-Rhodope orographic systems.

In Romania it is well spread throughout the country, showing broad ecological amplitude, the species mostly dwelling in dry habitats of higher rocky zones. According to *Atlas Florae Europaeae*, in Romania, it occurs over the entire Carpathian chain. The region involved in our study spans North of Danube being limited approximately by the 44° N to the South and by 46° N parallel to the north; and spanning between 21° E meridian to the West and 27° E meridian towards East. It comprises the mountains situated approximately between km 4900-5100N of the UTM projection zones 34 and 35.

The studied region comprises a wide variety of habitats from the Danube flood plains to the highest peaks in the Romanian Carpathian Mountains (an altitude ranging between 50-2550m s.m.).

The climate is extreme-continental characterized by wide annual and diurnal variations in temperature and rainfall, the region also showing similarly diverse ground cover and edaphic conditions.

This study presents a more precise distribution list of the sites from which *Jovibarba heuffelii* was mentioned and the first grid map in the UTM projection system depicting the species distribution in Southern Carpathian Mountains, together with some chorological and ecological considerations with regard to biotic and abiotic factors involved in its distribution.

Method

At this stage we have encompassed under *Jovibarba heuffelii* all the citations that were not obviously erroneous, considering all synonymised taxa that are presently assigned to *J. heuffelii*.

To establish the UTM geocodes for the locations cited we have used when applicable Lehrer's work about the cartography of Romanian fauna and flora using arealographic coordinates [17] or geocodes derived from GPS coordinate readings from surveys done by the authors. The UTM geocodes were given when possible for the closest human settlement available.

For the cases when the citations were too ambiguous or couldn't be precisely located, we have only indicated the UTM 100km-quadrants geocodes. For each location cited we have mentioned when available altitudes, citation sources and the name under which the plants were cited by each author where it differed from the accepted species name. Due to the limited space available and because this wasn't the objective of this study, we haven't presented in this report data like collection dates, ecological and phytosociological information which will form the object of a future article.

Results

Our results comprise a number of 183 citations of locations in which *Jovibarba heuffelii* was mentioned, sometimes redundantly. Out of these, 51 locations were reported before 1957, a number of 49 are reports published by other scholars after Răvăruț's monographic work from Flora RPR [25] until now, and a number of 83 are citations of new locations or older locations for which we have positively confirmed the presence of *J. heuffelii*. The locations were sorted by county and by UTM geocode (Table 1).

Table 1: The locations where *Jovibarba heuffelii* was mentioned

County	Location and Altitude (m. s. m.)	UTM Geocode*	Information Source**
AB	Sebeș	FR99	25
AG	Cheia Argeșului by Arefu (r. Curtea de Argeș)	LL12	25
AG	NE of Câmpulung: Mt. Mateiaș, limestone rocks, S and SSE	LL41	BN 04
AG	NE of Rucăr: limestone rocks in Pasul Giuvala, 1000 m	LL52	BN 04
AG	Rucăr above Ghimbav and by Dîmbovicioara	LL52	12
BV	Făgăraș Mts.	LL	25
BV	Gorges at the base of Mt. Piatra Craiului	LL64	18
BV	Zărnești in "Prăpăstiile Zărneștilor"	LL64	18
BV	Zărnești	LL64	25
BV	Râșnov	LL74	B 98
BV	Racoșu de Jos	LL79	25
BV	Postăvaru Mt.	LL84	25
BV	Orașul Brașov on Tîmpa	LL85	25
CS	Coronini	EQ55	B 93
CS	Cheile Nerei	EQ57	18, 28
CS	Valea Ciclovei	EQ58	29
CS	Cozla (Defileul Dunării)	EQ74	BN 04
CS	Drencova (Defileul Dunării)	EQ74	BN 04
CS	Plavișevița	EQ93	B 93
CS	Cheile Carașului	ER60	29, B 93
CS	Cheile Carașului și ale Gârliștei	ER60	29, B 97
CS	Cheile Gârliștei	ER60	29, B 84, 93, 97
CS	Doman	ER71	B 93
CS	Above Băile Herculane, near Mehadia, on limestone rocks	FQ07	18
CS	In the neighborhoods of Mehadia	FQ07	4
CS	Mt Străjuțului between Mehadia and Băile Herculane	FQ07	4

CS	Banat Arjana Mt (on the right side of Cerna valley)	FQ08	4, BN 95
CS	Globurău	FQ08	B 93
CS	Ciorici near Băile Herculane, on limestone rocks	FQ16	18
CS	Pecinișca near Băile Herculane, on limestone rocks	FQ16	18, B 93
CS	Băile Herculane (on the roof of the old firestation)	FQ17	4, B 97
CS	Cheile Rudăriei (W of Baile Herculane)	FQ17	18
CS	Mt Domogled near Băile Herculane 900-1060 m	FQ17	18, 9, B 93-99, BN 03, N 03
CS	Cornereva	FQ19	B 93
CS	Jidoștița	FQ25	B 93
CS	Gornenți	FQ27	B 93
DB	Piatra Craiului Mts., Cheile Dâmbovicioarei, above 700 m	LL52	B 87
DB	Curmătura Ghimbavului	LL62	10
DB	Culmea Zacotelor	LL63	10
GJ	Cloșani	FQ49	12
GJ	Motru Sec on limestone rocks intensively grazed and in cult,	FQ49	B 92
GJ	Mt Piatra Cloșanilor, on limestone rocks, intensively grazed and in cult	FQ49	B 92 , 18
GJ	Mehedinți Mts on Piatra Cloșanilor (r. Baia de Aramă)	FQ49	25
GJ	Parîngului Mts S of Mt Papușa, granite rocks, 1900 m	FR91	18
GJ	Lainici (r. Tg. Jiu); (S. of Petroșani)	FR93	12, 25
GJ	Porceni la iesirea Jiului din Surduc	FR93	25
GJ	Cheile Oltețului	GR10	B 04
GJ	Close to peștera Polovragi (Polovragi cave)	GR10	B 04
HD	E of Mt Petrei	FR	4
HD	Mt. Tomeasa (r. Hațeg)	FR	25
HD	Mt. Tomeasa near valea Rîul Mare, 1900m	FR	18, 4
HD	Parîngului Mts on "Badea", 1500-1800 m	FR	18
HD	Parîngului Mts valea Surducului la Pietrele Albe, shiestose rocks 550m	FR	18
HD	Retezat Mts, Gura Zlata	FR	25
HD	Retezat Mts, Lapuș	FR	25
HD	Retezat, by "Piept" on Valea Butei (Buta Valley) on limestone, 950 m	FR	18
HD	Retezat, Rîul Mare, near Gura Zlata 850 m s.m.	FR	18, 4, 5
HD	Valea Jiului	FR	12
HD	Valea Lapusnicului (downriver of Rîul Mare)	FR	4
HD	Valea Rîul Mare	FR	18, 4
HD	Valea Roșia in Retezat	FR	18
HD	Retezat, Valea Rîul Mare, on rocks, 900m	FR03	18, 5
HD	Boița	FR45	25
HD	Deva	FR48	25
HD	On rocks by Surduc, S of Petroșani, 1000 m	FR93	18
MH	Svinița (Defileul Dunarii)	EQ82	BN 04
MH	Balta Cerbului	FQ18	B 93, N 04
MH	Ineț	FQ18	B 93
MH	Mtii Cernei in. Țesna Valley (r. T. Severin)	FQ18	25
MH	Valea Țesnei	FQ18	12, BN 99, 00, N 03
MH	Cerna	FQ49	BN 04
PH	Bucegi, Lespezi Mt.	LL70	2
PH	Lespezi Mt aproape de Dobrești (r. Pucioasa)	LL70	25
PH	V. Ialomitei	LL71	25
PH	Bucegi Mt Zănoaga	LL72	2
PH	Zănoaga	LL72	25
PH	Bucegi Mt Batrîna, on the rock walls of Turnul Seciului	LL73	2, B 97
PH	Bucegi Valea Horoabei	LL73	2, 25
PH	Bucegi Babele	LL82	25

PH	Bucegi Piatra Arsă,	LL82	25
PH	Bucegi Poiana Sfîinii	LL82	25
PH	Bucegi Vf. Omu	LL82	25
PH	Sinaia at Sf. Anna rock	LL82	25
SB	Dealul Derşan, “Borciu”, rocks, 1050 m	KL	18
SB	Sibiu Mts on Dealul Caprei	KL	25
SB	Sibiu Mts on Piatra Şoimului	KL	25
SB	Sîlnca Biliana	KL	4
SB	Cristian de Sibiu	KL67	25
SB	Falkenstein in vaea Sadului near Rîul Sadului on limestone rocks	KL75	18
SB	Rîu Sadului (r. Sibiu)	KL75	25
SB	Valea Sădurelului (tributary of Riul Sadului, S of Sibiu), rocks, 850 m	KL75	18
SB	Cisnădioara	KL76	25
SB	Valea Sadului, S of Sibiu, on rocks, 1000 m	KL86	18
SB	Făgărăş on sandstone rocks near Vidraru Dam, W side, 800-900m	LL13	B 98
VL	Valea Oltului	KL	8, 12
VL	Mrea. Bistriţa şi Arnota	KL60	25
VL	Bărbăteşti in cult on roofs	KL70	B 98, N 01
VL	Buila Mts, Clăia Strâmbă-Livada cu Mesteceni	KL71	B 88, B 89, B 91, B 93, BN 97
VL	Buila Mts, Mt. Stogşoare, on “Scocul Ursului”	KL71	B 88, B 89, B 91, B 93, BN 97
VL	Buila Mts, Mt. Stogşoare, on the stonewalls by the tunnel	KL71	B 88, B 89, B 91, B 93, BN 97
VL	Buila Mts, Santinela Cheii	KL71	B 88, B 89, B 91, B 93, BN 97
VL	Buila Mts, Valea Cheii	KL71	B 88, B 89, B 91, B 93, BN 97
VL	Băile Olăneşti	KL80	B 92, B 92
VL	Pleaşa	KL80	B 97, B 92
VL	Valea Cheii	KL80	10
VL	above Stânişoara (towards Mt Cozia)	KL81	12
VL	Comanca	KL81	B 97, B 92
VL	Gurguiata	KL81	B 97, B 92
VL	Mt Cozia (E of Brezoi)	KL81	12
VL	Mt. Cozia Cascada Stânişoara, on rocks by the fall	KL81	B 97
VL	Mt. Cozia Stânişoara Monastery, on rocks and in cult.	KL81	B 97, 25
VL	Mt. Foarfeca	KL81	25
VL	Turnu Monastery on the rock “la chilie” and in cult.	KL81	B 97, B 04, B 03, B 02
VL	Valea Oltului close to Masa-lui-Traian	KL81	12, B 02, BN 03
VL	valea Oltului: upwords of Naroţu, S of Brezoi	KL81	12
VL	Brezoi, Valea Călineşti, on rocks, 800 m	KL82	8, 18

*The UTM geocodes were given when possible for the closest human settlement available, and when the locations couldn't be precisely located, we have only indicated the UTM 100km-quadrants geocodes.

**For the information source see the reference list. New locations or older locations in which we positively confirmed the presence of *Jovibarba heuffelii* (Schott) A&D Löve are highlighted. From these sites, specimens were photographed, and/or collected and stored dried or preserved in 90% ethanol in authors' collections. Also, many collected plants were transplanted and further cultivated in standard conditions in Bucharest by the authors. In several sites specimens were found in multiple years, which were equally mentioned for reference.

(BN + XX) = (Bărcă & Niculae + the last 2 digits of the year when the plant was found *in situ*) e.g. (BN 04) = (Bărcă & Niculae 2004)

(B + XX) = (Bărcă + the last 2 digits of the year when the plant was found *in situ*)

(N + XX) = (Niculae + the last 2 digits of the year when the plant was found *in situ*)

Some of the sites were impossible to assign definite UTM coordinates set, usually due to imprecise or insufficient data available. These sites were either discarded until further clarification, or were only mentioned in the table without placement on the map.

The following map (Figure 1) illustrates the distribution of *Jovibarba heuffelii* showing the selected mentioned sites that could be clearly located. For better clarity the map shows in a more convenient format the 100Km quadrants and the hydrographic network in the UTM system.

We have indicated the sites cited using different symbols for the 3 data subsets, of which the most important is the subset comprising the sites in which the presence of the species was positively confirmed by us. The other two subsets comprise the literature data that were divided using the monographic work of Ravarut [25] as milestone, as follows in figure 1.

The sites cited before 1950' were either mentioned again by Ravarut [25] or were found by us or other authors after Ravarut; consequently, they were not shown distinctly on the map, as they were positively confirmed by more recent studies. Also, previously cited sites confirmed by us have their reference sources mentioned in the table, but are depicted on the map with the symbol for the sites confirmed by us, as the presence of *Jovibarba heuffelii* (Schott) A&D Love is certain there at this moment.

Conclusions

This study reports findings of both literature survey and previously unpublished data from personal fieldwork of the authors. Our preliminary results indicate that, despite some new locations reported here by us, the distribution *Jovibarba heuffelii* (Schott) A&D Love populations is similar to the data previously published and largely agrees with the distribution published in Atlas Florae Europaeae [15].

Apparently, the limiting factor regulating the distribution of *Jovibarba heuffelii* (Schott) A&D Love to the mountainous zones in Romania is actually the fact this species is not capable of sustaining viable populations in habitats where it has to stand against competition. Another interesting factor involved in *Jovibarba heuffelii* (Schott) A&D Love distribution might be the fact that it was actively propagated by human populations in some places. This happened as a result of the medicinal and other household uses this species has in ethnic Romanian and German populations from some areas as described by us in a forthcoming paper.

Somewhat surprising, we have found this species thriving in moist mossy and shaded locations in one of which it was blooming with its roots being continuously soaked for at least several weeks. This type of behavior was reported by Lippert [19] for *S. hispanicum* L but never for *Jovibarba heuffelii* (Schott) A&D Love.

Typically *Jovibarba heuffelii* (Schott) A&D Love was frequently encountered in xeric habitats being found in the analyzed region in Romania in thermophylous associations as Popescu found it frequently in *Asplenietea*, *Seslerio-Festucion*, on rocky substrates [23]; and Roman reported it in 1974 along the Canyon of Danube also in *Asplenietea* [26]

The lowest altitude we have found populations of *Jovibarba heuffelii* (Schott) A&D Love was 63m *s. m.*, in the Canyon of Danube, but we believe it very probably grew in that location more than ten meters below this present level before the "Portile de Fier" dam was built and the retention lake was established.

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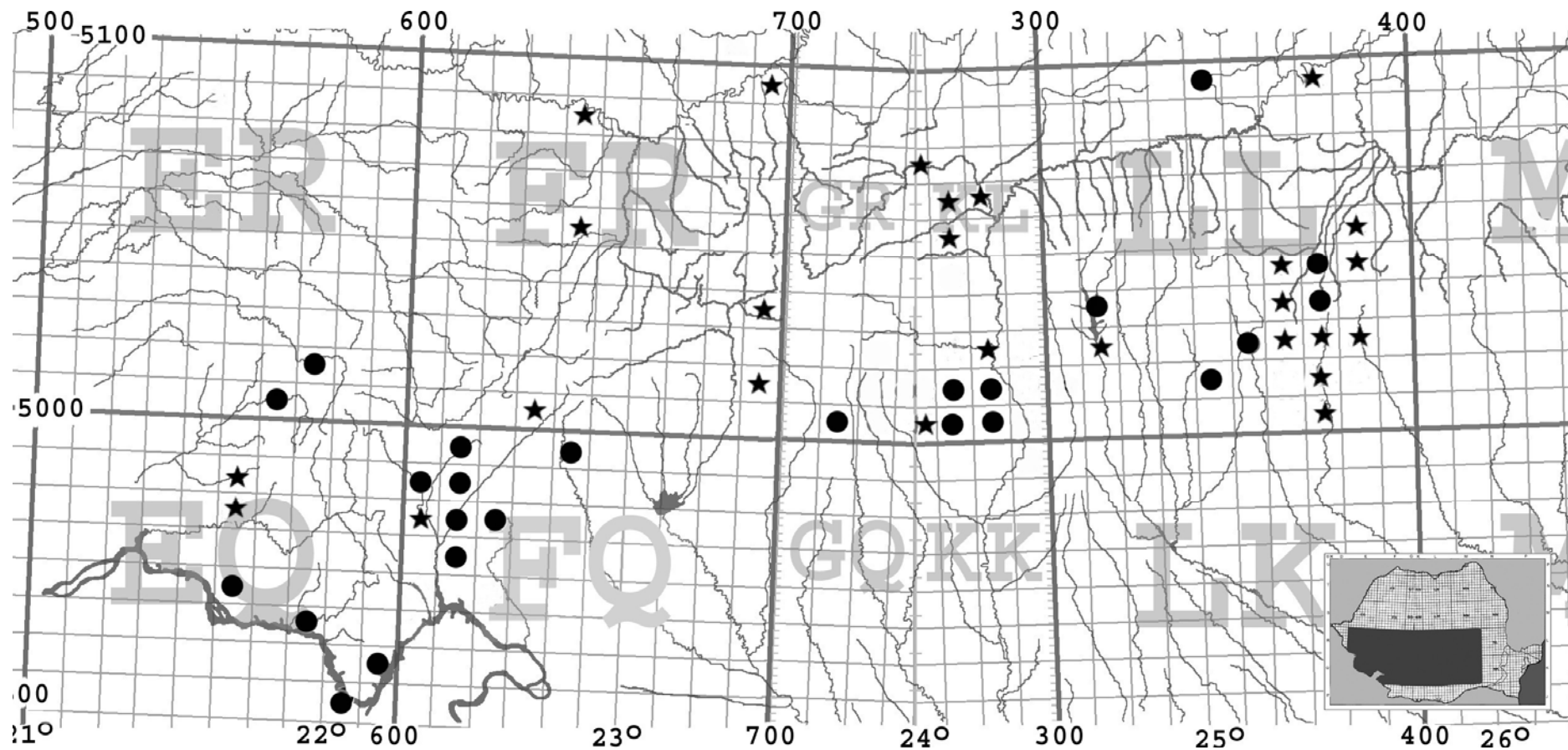


Fig. 1: Distribution map in UTM projection system with 100Km quadrants of the sites where *Jovibarba heuffelii* (Schott) A&D Love was positively identified.

The sites cited before 1957 were either mentioned again by Răvăruiț or were found by us or other authors after 1957; consequently, they were not shown distinctly on the map; ★ designates sites cited after 1957 by other authors and ● designates new sites or older sites in which we positively confirmed the presence of *Jovibarba heuffelii* (Schott) A&D Love.

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**DATE PRELIMINARE DESPRE COROLOGIA SPECIEI
JOVIBARBA HEUFFELII (SCHOTT) A. LÖVE & D. LÖVE (CRASSULACEAE)
ÎN CARPAȚII MERIDIONALI DIN ROMÂNIA**

(Rezumat)

Jovibarba heuffelii (Schott) A. Löve & D. Löve. este o Crassulaceae perenă, monocarpică, cu flori hexamere, cu petale gălbui și frunze ciliate, glandular păroase pe ambele fețe sau rareori glabrescente.

Specia este caracteristic carpato-balcanică, cu un areal cuprins între meridianele 18°E și 27°E. În România este răspândită în întreaga țară, unde are amplitudine ecologică mare, specia ocupând cu precădere habitate uscate din zone stâncoase înalte.

Zona luată în studiu se întinde la N de Dunăre, fiind limitată la N de paralela 46 și cuprinde biotopuri variate, de la Dunăre până la vârfurile cele mai înalte din Carpații Românești, (altitudinea variind între 50-2550m s.m.), cu o climă și pedologie de asemenea foarte variate.

Studiul nostru prezintă o listă cât mai completă a localităților din care a fost menționată specia *J. heuffelii* precum și o hartă raster în sistemul UTM a răspândirii acesteia în Carpații Meridionali. De asemenea, se fac considerații privind factorii biotici și abiotici care intervin în corologia și ecologia speciei care face subiectul acestui studiu.