THE CHOROLOGY OF THE SPECIES *Sedum annuum* L. (CRASSULACEAE) IN THE ROMANIAN EASTERN CARPATHIANS

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Abstract. *Sedum annuum* L. is a little annual species that perennates occasionally by nonflowering shoots, characterized by yellow 5-merous flowers with oval-lanceolate acute petals twice as long as the sepals, and allate follicles with short, initially erect stiles, later becoming divaricate, with round-tipped, linear, bright green leaves. The species has a pan-European distribution, with a range limited by 55°W and 32°E meridians, reaching the northernmost regions of Europe in Norway and Iceland. Previous data show a Romanian range covering sparsely the whole country, preponderantly in higher regions, the species having fairly large ecological amplitude with a preference for higher altitude and rocky places. The region involved in the present study mostly spans East of the Dâmboviţa River, approximately between 44.5°N and 48°N parallels, and 25°E to 28°E meridians. It includes mainly the mountains situated approximately between km 4950and 5300N and of the UTM projection zones 34 and 35, comprising a wide variety of habitats from the Danube and the Prut flood plains to the highest peaks in the Eastern Carpathian Mountains (an altitude ranging between cca. 50 and 2,500 m a.s.l.). The aim of this study was to assess the distribution of *S. annuum* in the Eastern Carpathian mountain range as I predict that the species has a much wider distribution than previously documented. I hereby present a comprehensive list of locations where the species *S. annuum* L was sighted, complemented by a map of the species distribution in the Romanian Eastern Carpathians together with some considerations about the chorology and the ecology of the species.

Keywords: *Sedum annuum* L., Crassulaceae, chorology, Eastern Carpathian Mountain range.

Rezumat. Chorologia speciei *Sedum annuum* L (Crassulaceae) în Carpaţii Orientali Româneşti. *Sedum annuum* L. este o mică specie care perenizează ocazional prin lăstari nefloriferi, caracterizată prin flori galbene pentamere cu petale oval-lanceolat-acute de două ori mai lungi decât sepalele şi folicule aripate cu stile scurte, iniţal erecte ce devin ulterior divaricate, cu frunze boante, liniare, verzi deschis. Specia are o distribuţie pan-Europeană, cu un areal limitat de meridianel 55°W şi 32°E, atingând cele mai nordice regiuni ale Europei in Norvegia şi Islanda. Datele anterioare arată un areal românesc acoperind răzleţ întreaga ţară, preponderent în regiunile înalte, specia având o amplitudine ecologică relativ mare cu preferinţă pentru locuri stâncoase la altitudinile mai ridicate. Regiunea implicată în prezentul studiu se întinde la Est de râul Dâmboviţa, aproximativ între paralelele 44.5°N - 48°N, şi meridianele 25°E - 28°E. Ea include în principal munţii situaţi aproximativ între km 4950-5300N ai zonelor 34 şi 35 ale proiecţiei UTM, cuprinzând o largă varietate de habitate de la luncile inundabile ale Dunării şi Prutului până la cele mai înalte vârfuri ale munţilor Carpaţi Orientali (o altitudine cuprinsă între cca. 50-2500 m deasupra nivelului mării). Scopul acestui studiu a fost evaluarea distribuţiei speciei *S. annuum* în lanţul munţilor Carpaţi Orientali cu predicţia că specia are o distribuţie mult mai amplă decât fusese documentată anterior. Prezint mai jos o listă comprehensivă de localităţi unde specia *S. annuum* L a fost găsită, completată de o hartă de distribuţie a speciei în Carpaţii Orientali Româneşti împreună cu unele consideraţii privind chorologia şi ecologia speciei.

Cuvinte cheie: *Sedum annuum* L., Crassulaceae, chorologie, Munţii Carpaţi Orientali.

INTRODUCTION

To this date there is no botanical work describing the complete distribution range of *Sedum annuum* (Linnaeus 1753) in the Eastern Carpathian mountain chain. Moreover, despite the relative richness of habitats and conditions for a diversified *Sedum* flora, no monograph on the genus *Sedum* from Romania was issued until now, while the only monographic treatment of this genus in Romanian flora has been published more than half a century ago (RAVARUŢ 1956). As shown for the Southern Carpathian mountain range, (NICULAE & BÂRCĂ, 2006), the sparse existing data published up to date about *S. annuum* L. suggest that its actual distribution in the Eastern Carpathian mountain range is much wider than previously documented. This, together with the increasing interest for the taxonomy, ecology, chorology and medicinal properties of Crassulaceae from the Carpathians (ARBUNE et al., 2009), (NICULAE & BÂRCĂ 2005, 2006), (BÂRCĂ & NICULAE 2005, 2006, 2008, 2011), (BÂRCĂ 2015, 2016), (STANCIU et al.,2009), prompted the attempt to fill at least part of this knowledge gap by providing comprehensive data about the chorology, ecology and phyto-sociology of this species in the Eastern Carpathian Mountains and the adjacent areas.

S. annuum L. is a usually annual species that perennates occasionally through "sterile" densely foliated shoots. Morphologically characterized by 5-merous shortly-pedicellate flowers with yellow petals, *S. annuum* L is a very polymorphic species, displaying a wide variation in many characters as: number of ramifications, shoot length, size and shape of inflorescence and floral parts, and floral morphology in general. Typically, it has fibrous roots, erect, simple or basally branched, 5-20cm tall, sometimes rooting stems, and alternate bright green, semiterrete, oblong-elliptic, cca. 5mm long, obtuse or rounded leaves, with a short, (whitish) basal spur. The inflorescence is a 1-3-ranched lax cyme having 5-25 shortly pedicellate flowers. The calyx is made of green, obtuse/rounded sepals of unequal length, corolla with elliptic-lanceolate yellow cca. 4mm long petals twice as long as the sepals. Follicles are brown, patent, each having conspicuous but small lips along the suture, with a short stile, initially erect but later becoming divaricate. Seeds are reticulate or reticulose-papillate, with short papillae.

Despite its mainly environmentally triggered polymorphism (HART, 1991), taxonomically, *S. annuum* L. represents a rather well-defined species, described by Linnaeus in (LINNAEUS 1753), (but having a perennating form described by Murbeck in 1892 under *S. annuumvar*. *perdurans*). Our observations in the field and in cultivated populations showed usual occurrence of perennating individuals amongst annual ones, independent of the site (NICULAE & BÂRCĂ, 2006), thus warranting at most the "form" ranking as previously stated by T'HART (1991).

From an ecological point of view, *S. annuum* L. is typically a calcifugous saxicolous arctic-alpine species, usually preferring sunny locations, xeric but not very dry alpine pastures with calcium-poor substrates, over well-drained bedrock, although it shows considerable ecological amplitude (NICULAE & BÂRCĂ, 2006). Coenologically, *S. annuum* L. is a characteristic species for Sedo-Scleranthion.

For more detailed information regarding the taxonomical treatment of *S. annuum* L in the Carpathians, its ecology and chorology see NICULAE & BÂRCĂ (2006).

The objective of this study was to provide a more comprehensive overall image of the actual distribution of *S. annuum*L.in the Eastern Carpathians mountain range as I predict that the species has a much wider distribution than previously documented. This work follows and complements that about the chorology of this species in the Southern Carpathians (NICULAE & BÂRCĂ, 2006) and will help scholars studying this species to better understand the biological, ecological and chorological features of this taxon. This study also forms the basis of a complete distribution map of *S. annuum* L. in Romania.

The area covered by this study extends North of the Danube and comprises approximately the mesoregions within the Outer and the Inner Eastern Carpathians units (sub–provinces) of KONDRACKI's (1978) division system, roughly occupying an area between 44.5°N and 48°N parallels, and between 25°E to the West and 28°E towards East, approximately between km 4950-5300N of the UTM projection zones 34 and 35. This region comprises a wide variety of habitats from the Prut flood plain to the highest peaks in the Eastern Carpathian Mountains (elevations ranging between cca. 50 and 2,500 m a.s.l.).

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

Our study presents a distribution list of the localities from which *S. annuum* L. was mentioned in the studied area, complemented by the first map of the distribution of this species in the Eastern Carpathian Mountains together with some considerations about the chorology and ecology of the species with regard to biotic and abiotic factors influencing this distribution.

MATERIALS AND METHOD

This distribution study includes plant specimens that are either: i-personally seen by me and/or Marilena Niculae during fieldwork trips; ii-herbarium specimens collected by other researchers; and iii-plants cited in the pertinent literature or in personal communications by other researchers. The most numerous source and the main contribution of this research is represented by the first category.

I have personally studied herbarium material located in the following herbaria from; Bucharest (BUCA, BUC, BUCF, BUAG), Braşov (BVS), Cluj (CL), Craiova (CRAI, CRAF) Iaşi (IAGB), Suceava (SV), Târgu Mureş, (TGMS), Krakow, (KRA), Madrid (MA), Montpellier (MPU), München (M, MSB), Prague (PRC), Vienna (W, WU) (Herbarium acronyms follow Index Herbariorum (THIERS, 2012) and incorporated data thus gathered where applicable along with data from fieldwork and personal collections of the author.

I have comprised under *S. annuum* L. all the citations/specimens that were not obviously erroneous, including the ones under *S. annuum var perdurans* Murd. The morphological characters used as taxonomical criteria to ascribe the plants found (either living or herbarium specimens) to the species *S. annuum* L. followed (NICULAE & BÂRCĂ, 2006) as mentioned above.

The geographical coordinates for the locations cited were derived from GPS coordinate readings from surveys done by the author, using a handheld GPS and where later crosschecked in the lab using ACME MAP version 2.1.

To achieve a consistent arealographic presentation that integrates the distribution of *S. annuum* L in the physiographic units of the Eastern Carpathians, into the general picture of the whole Carpathian Mountain range, I chose to use the hierarchical division system elaborated by KONDRACKI (1978) in KUKULA et al. (2003), corrected for Romania according to the regional map of orographic units after POSEA & BADEA (1984).

The map was modified based on the image "Romania.A2003126.0915. 250m.jpg" from NASA - National Aeronautics and Space Administration Visible Earth, Credit: Jeff Schmaltz, MODIS Rapid Response Team, NASA/GSFC.

The "locality" names for the collection sites were given when possible for the closest human permanent settlement available, and the "collection sites" are toponyms in Romanian (or the language of the original herbarium label notes, that gives some indications to the actual sites where the plants were found and for which the geographical coordinates are given. For a small number of the sites it was impossible to assign definite coordinates, 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. For the cases when the annotated data on the herbarium specimens were too ambiguous or could not be precisely located, I have only indicated the geographical coordinates for the closest human settlement available. For each location cited I 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. Because of the limited available space and because this was not the

objective of the present study, I give in this report only some limited data like collection dates, ecological and phytosociological information, which will form the object of a future article.

RESULTS

The results herein presented comprise over 160 mentions of *Sedum annuum* L. locations. Out of these, most are new locations or older locations in which I positively confirmed the presence of *S. annuum* L. The data are presented below in tabular format (Table 1) and as a distribution map (Fig 1.). The locations were sorted by county and by mesoregion codes, then alphabetically by local geographic name (mountain or region), where the mesoregions followed KONDRACKI (1978).

Table 1. Distribution list of *Sedum annuum* L. in the Eastern Carpathian Mts. within the mesoregions.

No.	County	Mount. or region	Mesoregion Name (1)	Meso. Reg. Code(2)	Locality (3)	Collection site, Habitat, Elevation m a.s.l.		Coordinates (4) Lat N Long E	Source (5)
1	BV	Postăvaru	Depresiunea Braşov	523.73	Bartolomeu	Behind the Bartolomeu Church rocks		N45.66184 E25.57626	BV87, BV90-09
2	BV	Postăvaru	Depresiunea Braşov	523.73	Braşov city	Turnul Negru	rocky rocksoutcrop ridge	N45.64146 E25.58533	BV90-09
3	BV	Postăvaru	Depresiunea Braşov	523.73	Braşov city	Greek Cemetery Cultivated/naturalized? On concrete slabs, crevices, gravel, old walls		N45.64178 E25.58688	BV00-10
4	BV	Postăvaru	Depresiunea Braşov	523.73	Braşov city	"După ziduri"	on old walls	N45.64249 E25.58733	BV90-09
5	BV	Postăvaru	Depresiunea Braşov	523.73	Hărman	Dealul Lempeş	On Rocks near the peak	N45.72389 E25.6588	BV95
6	BV	Postăvaru	Postăvaru	531.11		Schuler Siebenburgen			PRC #na
7	BV	Postăvaru	Postăvaru	531.11		Mt. Postăvaru, on "Drumu. Şerpilor"			N05 [in NB06]
8	BV	Postăvaru	Postăvaru	531.11	Braşov city	Solomon's Rocks	Rocks	N45.61731 E25.55883	BV95, BV03-09
9	BV	Postăvaru	Postăvaru	531.11	Braşov city	Tâmpa	On rocks	N45.63947 E25.60232	BV95, BV03-09
10	BV	Postăvaru	Postăvaru	531.11	Braşov city	Dealul Melcilor	On rocks	N45.64267 E25.60947	BV86-10
11	BV	Postăvaru	Postăvaru	531.11	Braşov city	Dealul Melcilor concrete slabs and rocky outgrops on Dealul Melcilor		N45.64448 E25.61317	BV86-10
12	BV	Postăvaru	Postăvaru	531.11	Braşov city	Dealul Melcilor	On rocks	N45.64454 E25.61515	BV86-10
13	BV	Postăvaru	Postăvaru	531.11	Braşov city	Warthe, -drumul Poieni	Small rocks	N45.64639 E25.5785	BV10
14	BV	Postăvaru	Postăvaru	531.11	Cheile Râşnoavei	"Muchia Căprioarei" ridge On rock clifs, ledges, outcrops		N45.54581 E25.51826	BV10
15	BV	Postăvaru	Postăvaru	531.11	Râşnov (Rosenau),	At Râşnov Fortress	On walls	N45.59071 E25.46898	BV86-10
16	BV	Postăvaru	Postăvaru	531.11	Timişu de sus	Spinarea Calului ridge	Rocks	N45.5557 E25.57274	BV10
17	BV	Postăvaru	Postăvaru	531.11	Valea Râşnoavei	"Sânca Prostului" climbing Rock	Rock	N45.54293 E25.52129	BV10, BV-11
18	BV	Piatra Craiului	Piatra Craiului	531.13	Bran -Poarta	Strunga Hut Roks and pinacles arround the hut On rocks 1893m		N45.39021 E25.40876	BV03-09
19	BV	Piatra Craiului	Piatra Craiului	531.13	Zărneşti	Prapastiile Zărneştilor Canion	Rock cliffs	N45.52739 E25.26823	BV03-09
20	BV	Piatra Craiului	Piatra Craiului	531.13	Zărneşti	Cabana Curmătura in the meadow N of the hut	Rocky outcrop in the meadow	N45.55074 E25.25551	BV03-09
21	BV	Piatra Craiului	Piatra Craiului	531.13	Zărneşti	"Drumul Prăpăstiilor" road, on the way to "Prăpăstiile Zărneştilor"Rocky outcrops		N45.54113 E25.29753	BV03-09
22	BV	Piatra Craiului	Piatra Craiului	531.13	Zărneşti	Cabana Curmătura in the meadow below the hut	On the rocks 1446m	N45.54937 E25.25591	BV85-87, BV03-09
23	BV	Piatra Craiului	Piatra Craiului	531.13	Zărneşti	Creasta Nordică	On rocks	N45.56 E25.26	CM08
24	BZ	Vrancei	Vrancei	525.1	Gura Teghii	Bâsca Concrete base of the bridge across the river Bâsca		N45.48511 E26.42031	BV07-11
25	BZ	Buzăului	Buzăului	525.2	Aluniş / BZ	Sandstone rocky outcrops close to the cave church	Sandstone rocky outcrops	N45.40972 E26.41366	BV10
26	BZ	Ciucaş	Buzăului	525.2	Cabana Muntele Roşu	In the meadow above the hut	Rocks 1281	N45.48821 E25.94091	BV10, BN05, N03
27	BZ	Ciucaş	Buzăului	525.2	Cabana Muntele Roşu	Rocky outcrops on the slope above the hut	Rocky outcrops	N45.49308 E25.94478	BV10
28	BZ	Ciucaş	Buzăului	525.2	Cabana Muntele Rosu	Rocky Outcrops in the forest	Rocky outcrops	N45.49436 E25.95595	BV10
29	BZ	Ciucaş	Buzăului	525.2	Cabana Muntele Roşu	Rocky Outcrops in the forest	Rocky outcrops	N45.49464 E25.95509	BV10

30	BZ	Ciucaş	Buzăului	525.2	Cabana Muntele Roşu	Rocky outcrops/pinnacles up the slope above the hut	Rocky outcrops	N45.49499 E25.95462	BV10, BN05, N03
31	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Pasul Bratocea	Rocky outcrops		N05 [inNB06]
32	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Pârâul Berii Leg.N. Puşcaş, C. Coldea			CL656698
33	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Zăganului	Rocky outcrops 1770m	N45.482 E25.982	BV10, BN05, N03
34	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Bratocei1	Rocky outcrops	N45.49132 E25.89026	BV10
35	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Bratocei	Rocky outcrops 1770m	N45.49201 E25.89537	BV10
36	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Bratocei2	Rocky outcrops	N45.49265 E25.89453	BV10
37	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Bratocei2	Rocky outcrops	N45.49317 E25.89745	BV10
38	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Colţii Bratocei2	Rocky outcrops	N45.49382 E25.89028	BV10
39	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Tigăi	Rocky outcrops	N45.51495 E25.9176	BV10
40	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Şaua Tigăilor	Rocky outcrops	N45.51584 E25.91857	BV10
41	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Şaua Tigăilor	Rocky outcrops 1751m	N45.5161 E25.918967	BV10
42	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Turnul lui Goliat	Rocky outcrops 1793m	N45.51852 E25.9174	BV10
43	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Turnul lui Goliat	Rocky outcrops 1793m	N45.51853 E25.91821	BV10
44	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Turnul lui Goliat	Rocky outcrops 1793m	N45.51921 E25.91383	BV10
45	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Turnul lui Goliat	Rocky outcrops 1793m	N45.51962 E25.91218	BV10
46	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Jgheabul Babele la Sfat	Rocky outcrops 1877m	N45.51972 E25.92944	BV10
47	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Jgheabul Babele la Sfat	Rocky outcrops	N45.51993 E25.92896	BV10
48	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Jgheabul Babele la Sfat	Rocky outcrops	N45.52006 E25.9287	BV10
49	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Jgheabul Babele la Sfat	Rocky outcrops	N45.52041 E25.92759	BV10
50	BZ	Ciucaş	Buzăului	525.2	Cheia/PH	Varful Ciucaş	Rocky outcrops 1958m	N45.52166 E25.9264	BV10
51	BZ	Siriu	Buzăului	525.2	Mt. Siriu	pe Valea Neagră legDihoru, 21.06.1957			BUCA147644
52	BZ	Siriu Mts	Buzăului	525.2	Nehoiasu	Rocky outcrops between Buzău river and Basca Rozilei creek Rocky outcrops		N45.44294 E26.31154	BV10
53	BZ	Siriu Mts	Buzăului	525.2	Nehoiu		Sandstone/cristaline Rocky outcrops	N45.40901 E26.32166	BV10
54	BZ	Siriu Mts	Buzăului	525.2	Siriu lake,	The road by the dam	concrete slabs	N45.49126 E26.25632	BV00-10
55	BZ	Siriu Mts	Buzăului	525.2	Siriu lake,	By the main road along the lake	rocky outcrops by the main road along the lake	N45.51704 E26.2135	BV00-10
56	CV		Bodoc	523.65	Bixad vicinity			N46.11128 E25.84817	BV09
57	CV		Bodoc	523.65	Bixad vicinity			N46.12534 E25.84949	BV09
58	CV	Depresiunea Ciuc	Depresiunea Ciuc	523.72	Micfalău	Outcrops W of Olt river and Micfalău village, N of Malnas Bai Rocks		N46.04621 E25.81699	BV9
59	CV	Depresiunea Ciuc	Depresiunea Ciuc	523.72	Micfalău	Outcrops W of Olt river and Micfalău village,, N of Malnas Bai Rocky outcrops		N46.04762 E25.81304	BV09
60	DB	Leaota	Leaota	531.12	Moroieni	Cheile Tătarului	Rock cliffs and ledges	N45.36193 E25.43054	BV09
61	DB	Leaota	Leaota	531.12	Campulung	Piatra Nămăeştilor (=Mt Mateiaşu?)	sub Sedum bolognense Lois	*N45.302 E25.132	W1904-33
62	DB	DB	Piatra Craiului	531.13	”Cheile Cheii	“upper stream of Dâmboviţa”		N45.4495 E25.2204	[Alexiu 2003]
63	DB	DB	Piatra Craiului	531.13	Cheile Dambovicioarei	“upper stream of Dâmboviţa” -		N45.4502 E25.2204	[Alexiu 2003]
64	HG	Giurgeului	Giurgeului	523.46	Borsec	Along a road off str Cimitirului	gravel	N46.96517 E25.57040	BV09
65	HG	Giurgeului	Giurgeului	523.46	Borsec	Old quary	carbonatic rocks	N46.96546 E25.57594	BV09
66	HG	Giurgeului	Giurgeului	523.46	Borsec	Poiana Zânelor carbonatic rocks by the quary close to "Poiana Zanelor"		N46.96766 E25.56718	BV09

67	HG	Harghitei	Harghitei	523.63	Tinovul Mohos	Meadow down the buildings	rocks on the meadow	N46.13350 E25.89544	BV09
68	HG	Depresiunea Ciuc	Depresiunea Ciuc	523.72	Frumoasa	By the dam	on concrete slabs	N46.44941 E25.87962	BV09
69	HG	Depresiunea Ciuc	Depresiunea Ciuc	523.72	Sândominic	Rock outcrop SW of the village	Rocks	N46.5714 E25.78145	BV09
79	HG	Depresiunea Ciuc	Depresiunea Ciuc	523.72	Tuşnad	On rocks, gravel, concrete slabs by a parking lot		N46.20687 E25.91125	BV09
80	MM	Rodnei	Rodnei	523.31		VF. Buhăescu Peak	on rocks 2124m	N47.57583 E24.63179	BV08, BV10
81	MM	Rodnei	Rodnei	523.31		Vf. Pietrosul Peak	on rocks	N47.59717 E24.63408	BV08, BV10
82	MM	Rodnei	Rodnei	523.31		Meteo Hut Pietrosul Rodnei	Rocks on the moraine near Meteo Hut	N47.60171 E24.6469	BV10
83	MS	Mureş Gorges	Calimani	523.62	Andreneasa	Lateral ditch and rock outcrops by the main road	Rocks and concrete slabs	*N46.96780 E25.02420	BV09, BV12
84	MS	Mureş Gorges	Calimani	523.62	Borzia/ Galaoaia,	Lateral ditch and rock outcrops by the main road close to the power plant Rocks and concrete slabs		N46.97270 E24.94547	BV09
85	MS	Mureş Gorges	Calimani	523.62	Meştera	Lateral ditch and rocks by the main road	Rocks and concrete slabs	N46.96683 E25.20463	BV09
86	MS	Mureş Gorges	Calimani	523.62	Meştera	Lateral ditch and rock outcrops by the main road	Rocks and concrete slabs	N46.96798 E25.19613	BV09
87	MS	Mureş Gorges	Calimani	523.62	Meştera	Lateral ditch and rock outcrops by the main road	Rocks and concrete slabs	N46.97065 E25.19471	BV09
88	MS	Mureş Gorges	Calimani	523.62	Răstoliţa	Lateral ditch and rock outcrops by the main road	Rocks and concrete slabs	N46.97299 E24.94713	BV09
89	MS	Mureş Gorges	Călimani	523.62	Stânceni	Lateral ditch and rocks by the main road	Rocks and concrete slabs	N46.96184 E25.23207	BV09
90	NT	Ceahlău	Ceahlău	523.45	Cabana Dochia hut	Rocks close to the hut	on rocky outcrops	N46.96505 E25.94934	BN04, BV08
91	NT	Ceahlău	Ceahlău	523.45	Ceahlău	Cascada Duruitoarea Waterfalls	on rocks by the falls	N46.97302 E25.93591	BN04
92	NT	Ceahlău	Ceahlău	523.45	Ceahlău	Meteo Hut "Toaca"	on rocky outcrops	N46.97542 E25.94857	BN04, BV08
93	NT	Ceahlău	Ceahlău	523.45	Ceahlău	"Cusma Dorobantului" rocks	on and by the rocky outcrop	N46.98583 E25.95965	BN04, BV08, BV10
94	NT	Ceahlău	Ceahlău	523.45	Ceahlău	"Cusma Dorobantului" rocks	on and by the rocky outcrop	N46.98583 E25.95965	BN04, BV08, BV10
95	NT	Hăşmas	Hăşmas	523.47	Bicaz Chei	Lateral road off main road in Bicaz Chei Stony outcrop by a road off main road in Bicaz Chei		N46.81584 E25.87672	BN04, BV08
96	NT	Hăşmas	Hăşmas	523.47	Bicaz Chei	Cheile Şugaului canyon confluence w Cheile Bicazului canyon Rocks		N46.82579 E25.84971	BN04, BV11
97	NT	Hăşmas	Hăşmas	523.47	Bicaz Chei	Across from the village Bicaz Chei Rock outcrop accross Bicaz Chei		N46.82616 E25.86718	BV08
98	NT	Hăşmas	Hăşmas	523.47	Bicaz Chei	Upstream of the hydroelectric dam	On the rocks nearby the dam	N46.93984 E26.09988	BV08
99	NT	Hăşmas	Hăşmas	523.47	Bicaz Chei	By the hydroelectric dam	On conrete slabs	N46.94002 E26.1015	BV08
100	NT		Hăşmas	523.47	Potoci	Potoci pisciculture station	On concrete walls	N46.95844 E26.11305	BV08
101	PH	Piatra Mare	Piatra Mare	525.3		Rock outcrops, pinacles	Rock outcrops	N45.5424 E25.64091	BV09
102	PH	Piatra Mare	Piatra Mare	525.3		Vf. Coada Pietrei Mari	Rock outcrops near the peak	N45.5498 E25.64705	BV09
103	PH	Piatra Mare	Piatra Mare	525.3		Rock outcrops, pinnacles (young shoots, w/o flowers)	Rock outcrops, pinacles	N45.55079 E25.64506	BV 09
104	PH	Piatra Mare	Piatra Mare	525.3		Piatra Mare Hut Rocky outcrop towards the hut (young shoots, no flowers)		N45.56041 E25.64671	BV 09
105	PH	Piatra Mare	Piatra Mare	525.3		7 Scări Canyon, Intrare in canionul Sapte Scari	rocks (young shoots, w/o flowers) 960	N45.56684 E25.64422	BV 09
106	PH		Gârbova	525.3	Podu Cheii	On sandstone conglomerate rocky outcrops by a creek sandstone conglomerate rocky outcrops		N45.21045 E25.75789	BV95
107	PH		Gârbova	525.3	Podu Cheii	On sandstone conglomerate rocky outcrops by a creek sandstone conglomerate rocky outcrops		N45.21441 E25.7586	BV95
108	PH		Gârbova	525.3	Podu Cheii	On sandstone conglomerate rocky outcrops by a creek sandstone conglomerate rocky outcrops		N45.21783 E25.75952	BV95
109	PH		Gârbova	525.3	Posada	By the main road	lateral ditch and stone/concrete wals	*N45.286 E25.617	BV94-5
110	PH		Gârbova	525.3	Valea Doftanei	Valea Doftanei, large sandstone conglomerate rocky outcrop by the river Paltinu dam sandstone conglomerate rocky outcrop		N45.20845 E25.74102	BV94-5

111	PH		Gârbova	525.3	Valea Doftanei	Paltinu dam	on rocks and concrete slabs by the dam	*N45.24476 E25.73715	BV94-5
112	PH		Gârbova	525.3	Valea Doftanei	Paltinu dam on rocks and concrete slabs/blocks by the dam		N45.24566 E25.73596	BV94-5
113	PH		Subcarp.Muntelniei /Buzău	526.2	Gura Vadului / PH		concrete slabs of a runoff ditch	N45.03582 E26.4325	BV13
114	PH		Subcarpații Munteniei /Buzău	526.2	Mizil	Dl. Ciortea, E de satul Tătaru 08.06.1961		*N45.100 E26.341	BUC317319
115	PH	Bucegi	Bucegi	531.11	[Sinaia}	V. Furnica 05.07.1911		N45.407 E25.511	I-5846
116	PH	Bucegi	Bucegi	531.11	[Bușteni]	bei Malajester Schutzhutte Bucegiu	Am Felsen	N45.407 E25.511	W1926-277
117	PH	Bucegi	Bucegi	531.11	Bran	Șeaua Strunga	Rocks 1900m	N45.39076 E25.40823	BV10
118	PH	Bucegi	Bucegi	531.11	[Bușteni]	Jepii Mari Leg Nyarady 10.08.1929		N45.407 E25.511	CL196700, 05
119	PH	Bucegi	Bucegi	531.11	[Bușteni]	Coștila deasupra Văii Albe LegP. Cretzoiu 25.07.1944		N45.407 E25.511	BUAG6537
120	PH	Bucegi	Bucegi	531.11	Bușteni	Vâlcelul Spumos		N45.407 E25.511	B1994
121	PH	Bucegi	Bucegi	531.11	Bușteni	Brâna Caprei la iesirea din Valea Coștilei		N45.407 E25.511	(B1994)
122	PH	Bucegi	Bucegi	531.11	Bușteni	Valea Alba, close to the old Schi Hut		N45.407 E25.511	(B1994)
123	PH	Bucegi	Bucegi	531.11	Bușteni	Poiana Coștilei on rocky outcrops		N45.407 E25.511	BV10
124	PH	Bucegi	Bucegi	531.11	Bușteni	Refugiul Salvamont Bușteni (Jepii Mici)	Rocks 1140m	N45.40785 E25.51063	BV87-10
125	PH	Bucegi	Bucegi	531.11	Bușteni	Under the cable car	on rock clifs, ledges, outcrops	N45.40787 E25.51349	BV10
126	PH	Bucegi	Bucegi	531.11	Bușteni	Cabana Caraiman Hut	Rocks behind the hut 2041m	N45.40837 E25.48642	BV95-96
127	PH	Bucegi	Bucegi	531.11	Bușteni	Brâna Caprei x Valea cu apa a Caraimanului (V. Jepilor) Rocks		N45.41178 E25.49820	BV95-96
128	PH	Bucegi	Bucegi	531.11	Bușteni	VL. Spumoasa x Brâna Portitei	Rocks 1875m	N45.41187 E25.49821	BV95
129	PH	Bucegi	Bucegi	531.11	Bușteni	Portița Caraimanului	Rocks 1987m	N45.41402 E25.50257	BV96
130	PH	Bucegi	Bucegi	531.11	Bușteni	Crucea Caraimanului	Rocks 2260m	N45.41575 E25.4977	BV96
131	PH	Bucegi	Bucegi	531.11	Bușteni	Deasupra circului Nordic al Văii Albe	Rocks	N45.42232 E25.48743	BV95
132	PH	Bucegi	Bucegi	531.11	Bușteni	Intrare Horn Jilipeanu (Platou)	Rocks 2387m	N45.42588 E25.49265	BV95
133	PH	Bucegi	Bucegi	531.11	Bușteni	Releu Coștila	Rocks	N45.42711 E25.48499	BV97
134	PH	Bucegi	Bucegi	531.11	Bușteni	Hornurile lui Jilipeanu. la iesirea din V. Coștilei	Rocks 2390m	N45.42850 E25.49082	BV95
135	PH	Bucegi	Bucegi	531.11	Bușteni	Creasta Coștila - Gălbenele	jnepenis 2000-2370m	N45.43065 E25.49683	BV10
136	PH	Bucegi	Bucegi	531.11	Bușteni	Valea Coștilei "Țancul Ascutit" pinacle	Rock cliff	N45.43224 E25.49505	B1987-99
137	PH	Bucegi	Bucegi	531.11	Bușteni	Valea Gălbenele	Rock ledges and fissures	N45.43228 E25.49499	
138	PH	Bucegi	Bucegi	531.11	Bușteni	Valea Coștilei above the Climbing Hut	Rock ledges and fissures	N45.43229 E25.49514	BV87-10
139	PH	Bucegi	Bucegi	531.11	Bușteni	Creasta Balaurului	rocks	N45.4538 E25.4700	BV93
140	PH	Bucegi	Bucegi	531.11	Bucegi,	Poiana Stena regala	solo calcareo ca 1250m	*N45.35 E25.55	PRC #na
141	PH	Bucegi	Bucegi	531.11	Poiana Țapului	Leg P. Bănărescu .07.1939		*N45.380 E25.544	BUCA145845
142	PH	Bucegi	Bucegi	531.11	Sinaia	Piatra Arsă Leg Grințescu, 1.07,		*N45.35 E25.55	BUAG21502
143	PH	Bucegi	Bucegi	531.11	Sinaia	Piatra Arsă,		N45.35 E25.55	BV95
144	PH	Bucegi	Bucegi	531.11	Sinaia	St Anna rocks	rocks(young shoots, w/o flowers)	N45.35979 E25.5234	BV94
145	PH	Bucegi	Bucegi	531.11	Sinaia	Stâncile Ferdinand rocks	rocks	N45.37083 E25.526	BV94,BV09

146	PH	Bucegi	Bucegi	531.11	Sinaia	Piciorul Pietrei Arse	1900-1930m	N45.3729 E25.5xxx	BV09
147	PH	Bucegi	Bucegi	531.11	Sinaia	Cabana Piatra Arsă	Rocks N of the hut	N45.3835 E25.4877	BV93-94, BV10
148	PH	Bucegi	Bucegi	531.11	Sinaia	Leg Dihoru,.06.1955		*N45.35 E25.55	BUCA147649 N05
149	PH	Bucegi	Bucegi	531.11	Sinaia	Piatra Arsă leg Procopeanu.,07.07.1886		*N45.35 E25.55	CL48465
150	PH	Bucegi	Bucegi	531.11	Bran	Varful Scara	Rocks 2420m	N45.44854 E25.43341	BV05
151	SV	Rarău	Rarău	523.42	Cabana Zugreni hut	Cheile Zugrenilor Canion	rocks by the main road 736m	N47.4076 E25.51927	BV04, BV08, BV10, BV12
152	SV	Rarău	Rarău	523.42	Câmpulung Moldovenesc	At the base of the bridges over Moldova river	and on nearby small rocky outcrops	N47.5144 E25.6284	BV08, BV10, BV12
153	SV	Rarău	Rarău	523.42	Chiril	Pietrele Doamnei Rocks	on rocks	N47.44791 E25.56282	BV04, BV08, BV10, BV12
154	SV	Rarău	Rarău	523.42	Hotel Rarău	Hotel Rarău Rocks arround the buildings, on the roof of a garage/hut? 1510m		N47.44792 E25.55845	BV04, BV08, BV10, BV12
155	SV	Rarău	Rarău	523.42	Meteo Hut Rarău	Rocky pinnacle in the meadow beneath the Meteo Hut Rarău Carbonatic rocks		N47.44999 E25.5718	BV04, BV08, BV10, BV12
156	SV	Rarău	Rarău	523.42	Meteo Hut Rarău	Nearby Meteo Hut Rarău	on rocky outcrops	N47.45022 E25.56782	BV08, BV10
157	SV	Rarău	Rarău	523.42	Slătioara	Piatra Zimbrilor rocks	on rocky outcrops	N47.447 E25.562	BV04, BV08, BV10
158	SV	Rarău	Rarău	523.42	Valea Bistriţei DN17B	Rocky outcrops by the road	on rocky outcrops	N47.36314 E25.59824	BV10, BV12
159	SV	Rarău	Rarău	523.42	Valea Bistriţei DN17B	X with Chiril creek, rocky outcrops by the road	on rocky outcrops	N47.36314 E25.59824	BV09, BV10, BV12
160	SV	Mestecanis	Mestecanis	523.41/42		Pasul Mestecăniș	Rocks by the main road 965m	N47.4508 E25.33938	BV08, BV12
161	SV	V. Bistriţei	Rarău	523.42	Broşteni V. Bistriţei	Right bank by the bridge at the x w Neagra creek,	concrete slabs	N47.23672 E25.69583	BV08, BV10
162	BT	Lunca Prutului	Lunca Prutului	na.	Ripiceni	Old State Dairy Farm	Rocs and buildings of the farm	N47.96298 E27.13573	BV02
163	BT	Lunca Prutului	Lunca Prutului	na.	Ripiceni	Prut River	Rocky outcrop on Prut River	N47.96471 E27.14027	BV02
164	BT	Lunca Prutului	Lunca Prutului	na.	Sadoveni	Volovat;Prut River	- Rocky outcrop on Prut River	N47.97318 E27.12479	BV02
165	BT	Lunca Prutului	Lunca Prutului	na.	Sadoveni	Volovăţ	Rocky outcrops on Volovat creek banks	N47.97364 E27.13152	BV02
166	BT	Lunca Prutului	Lunca Prutului	na.	Stânca Ştefăneşti	Prut River Rocks and concrete slabs near the dam over Prut River		N47.83819 E27.22806	BV02
167	?	?	?	?	(in: Iter Romanicum 1931No565) PRC Herb. K Domin et V Krajina				

(1) MesoReg. Name and (2) MesoReg. Code follow the Mesoregions' names and codes from KONDRACKI (1978)
(3)The coordinates were given when possible for the closest human settlement available,
(4) The **l**ocality name was given for the closest human settlement available,
(5) For the information source se the references list. In several sites specimens were found in subsequent years, which were equally mentioned for reference. [CM08 = Carmen Manole *pers. comm.* 2008, NB06 = NICULAE & BÂRCĂ, 2006.
(BN + XX) = (BÂRCĂ & NICULAE + the last 2 digits of the year when the plant was found *in situ*) *e.g.* (BN 04) = (BÂRCĂ & NICULAE, 2004)
(BV + XX) = (BÂRCĂ + 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*)

DISCUSSIONS

The results presented herein (Fig 1. and Table 1) indicate that, like for *Sedum hispanicum* L. (NICULAE & BÂRCĂ, 2005) and *S. annuum* L in the Southern Carpathians (NICULAE & BÂRCĂ, 2006), the range occupied by S. *annuum* L is larger than previously documented (RAVARUŢ, 1956; WEBB, 1964; MEUSEL et al., 1965; BELDIE, 1967; LIPPERT, 1995; JALAS et al., 1999; ALEXIU, 2003). Like in the Southern Carpathians, the species was sometimes confounded with *S. acre* L. and probably often under-reported by previous authors, its occurrence being probably considered unworthy of mentioning from all locations where it was found, this fact compounding the misidentification problem and leading to problems in establishing a correct distribution range of *S. annuum* L. in Romania.

From an ecological standpoint, there are notable differences from the characteristic habitat preferences described in other mountain ranges, where it is one of the characteristic species for sub-thermophilic pioneer communities of the *Sedo-Scleranthion* alliance, developing on superficial soils on siliceous rock outcrops.

Thus, some populations from both Southern and Eastern Carpathians have a pronounced calciphilous character, sometimes dominating the open xerothermophilic pioneer communities developing on shallow calcareous soils, more characteristic to *Alysso alyssoidis-Sedion albi* Oberdorfer et Müller. The ecological and phyto-sociological characteristics of *S. annuum* L in the Eastern Carpathians warrant a more thorough discussion and form the substance of another article (BÂRCĂ in prep.)

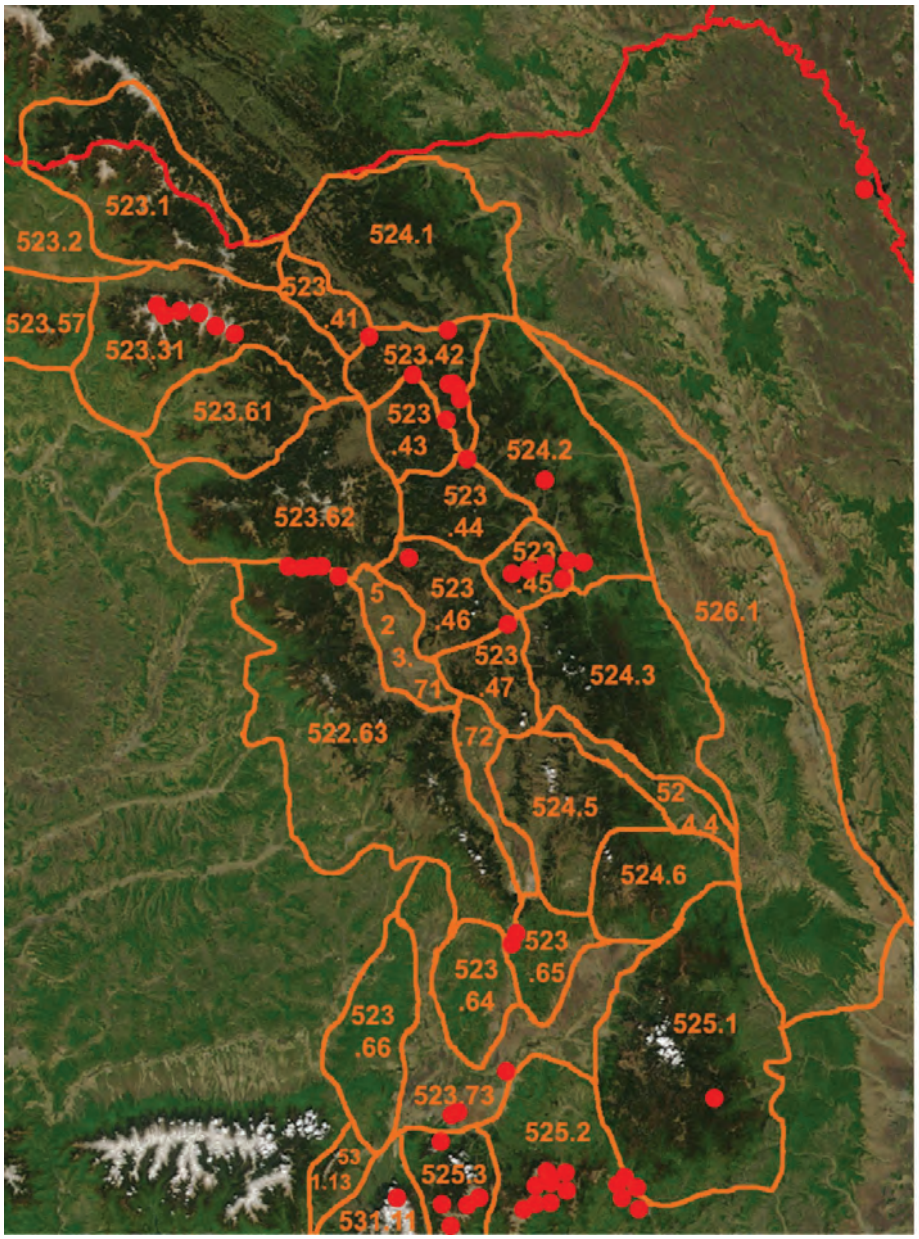

Figure 1. Schematic distribution map of *Sedum annuum* L in the Eastern Carpathians within the mesoregions after KONDRACKI (1978).

CONCLUSIONS

The number of new sites presented herein documents for S. annuum a distribution in the Eastern Carpathians that is much larger than previously thought. In most of the plant communities found in many sites, *S. annuum* occurs together with the very similar species *S. acre* and/or *S. sexangulare*, fact that predisposes it to confusions with these two species and leads to underreporting.

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