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Scorzoneroides crocea (Haenke) Holub, a new species in the flora of Slovenia and the Southeastern Alps

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Summary: A new locality of the East Alpine-Carpathian species *Scorzoneroides crocea* (= *Leontodon croceus*), the first in the Southeastern Alps as well as in Slovenia, is described. It was found on mountain pasture Klek (Pokljuka, the Julian Alps), on very small surfaces in the stands of the association *Homogyno alpinae-Nardetum strictae*. In our opinion, this character species of subalpine-alpine acidophilous grasslands grows in the limestone Julian Alps because of the specific site conditions (cold microclimate, leached brown soils) in the depressions of Alpine plateaus.

Keywords: *Scorzoneroides crocea*, *Leontodon croceus*, *Homogyno alpinae-Nardetum strictae*, leached brown soils on dolomite and limestone, mountain pasture Klek, Julian Alps, Slovenia

On 17th July 2009, during our research of flora and vegetation on mountain pasture Klek (Pokljuka, the Julian Alps, Slovenia) and the surrounding larch forests, a species of the genus *Leontodon* s.l. was found on two small areas. It was determined as *Scorzoneroides crocea* (Haenke) Holub (= *Leontodon croceus* Haenke) according to Fischer et al. (2008: 957) and Aeschimann et al. (2004b: 628). This species is not only new to the flora of Slovenia, but also to the flora of the entire Southeastern Alps. Therefore it will be presented in this article together with the special site conditions of the new locality.

Scorzoneroides crocea is an East Alpine-Carpathian species (Aeschimann et al. 2004b: 628), whose classic locality is in the "Judenburger Alpen", now Seetaler Alpen, Austria (Jacquin 1789: 16–18). The first to have thoroughly studied its distribution was Widder (1927), who also critically reviewed the material of herbarium collections of the time. He established that the species has two rather distant partial distribution areas. On the eastern edge of the Alps its distribution is limited to the Noric Alps (= Lavanttaler Alpen with four distinct mountain ranges: Seetaler Alpen, Saualpe, Stubalpe, Koralpe) and, reportedly, the easternmost part of the Niedere Tauern (Seckauer Alpen). According to Widder (1927), it grows in the Eastern Carpathians, in the eastern part of the Forest Carpathians (Waldkarpaten – Lisysti Karpaty) and in the Rodna Mountains (Rodnaer Alpen – Munții Rodnei). Hegi (1928: 1023) repeats these data, erroneously adding the phrase "für das Burgenland fraglich", which correctly should be read "für das Burzenland fraglich", i.e., doubtful for Țara Bârsei [in Romania] (H. Niklfeld, in litt.). Later the distribution of *Leontodon croceus* in Austria was discussed with short phytogeographical comments by Niklfeld (1973a: 56, 1973b: 139, 142). Also Fischer et al. (2008: 957) states its occurrence in Austria, namely in Carinthia and Styria (the Noric Alps and Seckauer Alpen), as well as its occurrence in the Eastern Carpathians.

The presence of *Scorzoneroides crocea* in the Niedere Tauern (Seckauer Alpen = "Gebiet des Seckauer Zinken" (Widder 1927)) is questionable. Though an occurrence in this mountain range was reported not only by Widder (l.c.), but also by later authors (Niklfeld 1973b; Pittoni

1974; Maurer 1998), these records are based only on three herbarium specimens from the early 19th century with a possibly confused origin (H. Niklfeld, in litt.).

According to Flora Europaea (Finch & Sell 1976: 311), where the species is circumscribed in a broader sense, the distribution area of *Leontodon croceus* encompasses the Eastern Alps, the Eastern and Southern Carpathians (where the typical subspecies *Leontodon croceus* subsp. c*roceus* supposedly grows) and the Bulgarian mountains. A particular subspecies – *L. croceus* subsp. *rilaensis* (Hayek) Finch & P. D. Sell – is indicated for Bulgaria as well as for the Southern Carpathians in Romania (therefore, both subspecies would be present there). The latter taxon is treated by other authors as an independent species *Leontodon rilaënsis* Hayek (Widder 1927; As'ov et al. 2001; Greuter et al. 2006) whereas in Prodromus Florae Peninsulae Balcanicae (Hayek 1931: 811) it is quoted as *Leontodon montanus* subsp. *rilaensis*. Further isolated records exist for the Kosovo side of the North Albanian Alps (Dobroško jezero on the eastern slope of Bogićevica range: Gajić 1975: 276 under *L. montanus* var. *rilaensis* (Hayek) Gajić) and for Macedonia (Jablanitsa Mt. near Labunista Lake: leg. B. Kitanov 15. 8. 1947, published in Dimitrov (1997) under *L. riloensis* Hayek). Italy is also one of the countries mentioned by Flora Europaea where *L. croceus* supposedly grows, but this information is most likely incorrect (Widder 1927). The absence from Italy is confirmed by the Euro+Med Plantbase (Greuter 2006–2009).

In the Carpathians, *Scorzoneroides crocea* has recently confirmed localities in Ukraine (the Gorgany, the Svydovets, the Chornohora and the Marmarosh Mts.) – Y. Kobiv (in litt.) and in Romania (the Marmarosh [Maramureş] Mts., as well as the area from the Rodna to the Hăşmaş Mts.) – G. Coldea (in litt.). In the Southern Carpathians *Scorzoneroides crocea* is replaced by the closely related *Scorzoneroides rilaensis* (= *L. rilaensis*). In this area, Widder (1927) admits the occurrence of transitional forms but not of pure *L. croceus* (a few old herbarium sheets are interpreted by Widder as confused). Coldea (1990) and collaborators have reviewed the herbarium material from Cluj and the literature data concerning the distribution of *Leontodon croceus* s. str. in the Southern Carpathians and concluded that the data from the Bucegi, Făgăraș and Piatra Craiului Mts. are very old (from the beginning to the middle of the 19th century), dating from a time before the separation into two subspecies of the taxon *Leontodon croceus* s. lat. The herbarium material from the Capatanei Mts., however, has been collected more recently (1958, 1961 by Dr M. Ciurchea) and belongs to *Leontodon croceus* s. str., just like the plant material from the Parâng Mts. collected by S. Bogsch in 1914.

Figure 1 provides a synoptic map of the entire distribution of *Scorzoneroides crocea* subsp. *crocea* with the new locality plotted in the Julian Alps. It's based on following data:

Austria: Hartl et al. (1992), Pittoni (1974), Maurer (1998) and corrections, and unpublished data from "Mapping the Flora of Austria" communicated by H. Niklfeld (University of Vienna).

Ukraine: Widder (1927), Klokov (1965), A. Kagalo (still unpublished data for an international research project, "IntraBioDiv", 2004–2006, communicated by H. Niklfeld), Y. Kobiv (in litt., a map based on his own experience, literature and herbarium data) and N. N. Sychak (in litt., herbarium data from the collections LWKS, KW and LW).

Romania: Nyárády (1965) and G. Coldea (in litt., a map based on his own experience, literature and herbarium data).

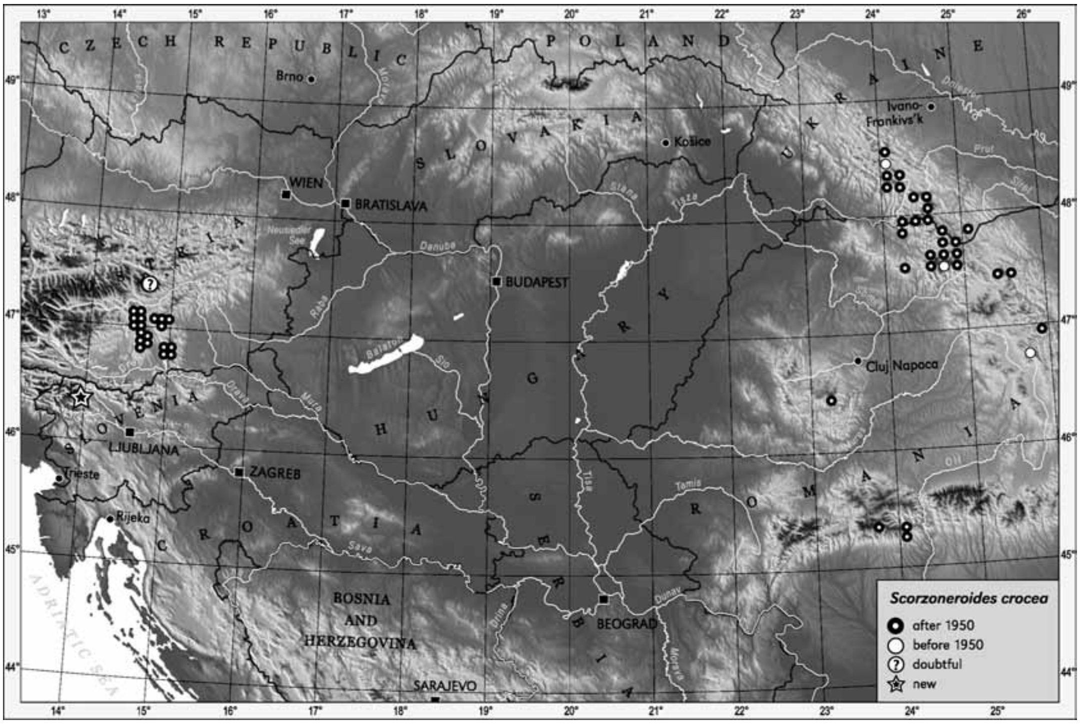

Figure 1. Distribution of *Scorzoneroides crocea* subsp. *crocea* (= *Leontodon croceus* subsp. *croceus*) with the new locality in the Southeastern Alps (elevation data according Jarvis et al. 2008).

Recent molecular investigations have confirmed the division of the genus *Leontodon* not only into two subgenera (subgenus *Oporinia* and subgenus *Leontodon* – compare, e.g., Widder & Pittoni 1975), as it has been divided to date, but into two independent genera: *Leontodon* L. and *Scorzoneroides* Vaill. (formerly *Leontodon* subg. *Oporinia*). According to this new systematic division, *Leontodon croceus* is classified into the new genus as the taxon *Scorzoneroides crocea* (Haenke) Holub (Samuel et al. 2006; Gutermann 2006; Greuter et al. 2006; Fischer at al. 2008).

Scorzoneroides crocea is a 10–40(–45) cm high perennial plant (hemicryptophyte) with an upright, sometimes even oblique rhizome. The stem is erect and usually single (more rarely there are two or three stems), distinctly thicker under the head and hairy at the top (blackish and whitish hairs). The peduncle bears a few linear or linear-lanceolate scale leaves. Stem leaves are arranged in a rosette that is not sessile to the ground; they are narrowly lanceolate, normally only with sparse hairs on the margins and underneath along the central rib (nervure), almost sessile. The capitulum (head) is medium sized (3–4 cm in diameter), erect before efflorescence, the involucre is approximately 1 cm long. Involucral leaves are linear, narrowly rimmed, black-green with black and single white hairs. The flowers, especially lingulate, and the pistil are bright, saffron yellow or orange-yellow. Time of flowering: July and August.

Widder (1927: 287–288) describes the sites of *Scorzoneroides crocea* (= *Leontodon croceus*) as follows: moist depressions, gullies, hollows, slopes with abundant surface water, overgrown with mountain meadows and low shrubs at the altitudes between 1600 m to 1800 m, individually even higher – up to 2100 m (2280 m in the Carpathians). The predominating geological bedrock in the Eastern Alps is silicate (gneiss and other metamorphic rocks), very rarely also carbonate. In the Carpathian part of the distribution area this species grows also on mixed silicate-carbonate and pure carbonate bedrock. The ecological description in Flora alpina (Aeschimann et al. 2004b: 628) is as follows: the geological bedrock is silicate, mixed silicate/carbonate, more rarely carbonate; the soil reaction is neutral, rarely acid or alkaline; the soil is poor in nutrients and medium moist. According to this source, it is a species of the subalpine belt, a character species of the class *Juncetea trifidi = Caricetea curvulae* (i.e., the communities of subalpine-alpine acid grasslands of Central- and Southern-European high mountains). A description of sites and phytosociological characteristics of *Scorzoneroides crocea* in the Saualpe was published by Franz (1999: 41, 43). Most commonly, this species thrives there on moist and more or less deep soils, in depressions and gullies with abundant surface water, under blanket bogs, e.g., in stands with dominant *Deschampsia cespitosa* and *Caltha palustris*. He found it (as rare, r) also in a stand of the association *Caricetum sempervirentis* Rübel 1911 and in a tall herb community with dominant *Peucedanum ostruthium* and *Poa chaixii*. The description of sites and plant communities in the eastern Carpathians, where *Scorzoneroides crocea* also grows, was contributed by Deyl (1940) and Coldea (1990). Deyl (1940) noticed this species under *Leontodon aurantiacus* in many subalpine grass- and tall herb communities, e.g. in the association *Festuca picta-Leontodon aurantiacus* (which appears to be the eco-sociological optimum of *L. croceus* (on Mt. Pop Ivan)). Coldea (1990) noticed *Scorzoneroides crocea* in the stands of two associations of the alliance *Potentillo-Nardion* Simon 1957: *Poetum mediae* Csürös 1956 and *Scorzonero roseae-Festucetum "nigrescentis"* (Pusc. et al. 1956) Coldea 1987. According to G. Coldea (in litt.), this species was also identified in the stands of the following syntaxa: *Festucetum pictae* Krajina 1933 (alliance *Festucion pictae* Krajina 1933), *Doronico austriaci-Adenostyletum alliariae* Horvat ex Horvat, Glavač et Ellenberg 1974 (alliance *Adenostyllion alliariae* Br.-Bl. 1926) and *Vaccinio-Rhododendretum myrtifoliae* Borza (1955) 1959 (alliance *Rhododendro-Vaccinion* Br.-Bl. 1926). The eco-sociological amplitude of *Scorzoneroides crocea* is broader in the Carpathians than in the Alps, perhaps because of the absence of the virtually competing *Scorzoneroides helvetica* from the Carpathians, which occupies the drier and more elevated habitats in the Alps (H. Niklfeld, in litt.).

Materials and methods

The flora and vegetation on mountain pasture Klek were recorded by means of established Central-European methods (Ehrendorfer & Hamann 1965; Braun-Blanquet 1964). Field data (floristic records and phytosociological relevés) were entered into the FloVegSi database (Seliškar et al. 2003). This application was subsequently used in the preparation of a distribution map of the studied species in Slovenia (Fig. 4). Relevés on the site of *Scorzoneroides crocea* were arranged into a table and the species classified into syntaxonomical groups, with special consideration of Flora alpina (Aeschimann et al. 2004a, b, c). Soil samples were collected at different depths on the first research plot and were subsequently analyzed in the pedological laboratory of Slovenian Forestry Institute. They were taken at three places in steps of 5 cm to a depth of 10 cm, and then in steps of 10 cm: 0–5 cm, 5–10 cm, 10–20 cm, 20–30 cm and 40–50 cm. All samples were put together (composite sample) and first air dried, then dried at 40 °C and stored until further preparation. Soil samples were crushed and sieved through a 2 mm test sieve. For all samples, pH, C/N, soil texture, cation exchange capacity and carbonates content were analyzed applying the following methods: pH in calcium chloride following ISO 10390 on automatic pH-meter

Metrohm Titrino, C and N content using dry combustion (ISO 10694) and/or 13878 on Leco CNS-2000, carbonates following ISO 10693 with Scheibler calcium-meter Eijkelkamp, and soil texture following ISO 11277 with sedimentary method and Köhn pipette.

The air temperature in the frost hollow on pasture Klek in the period from 31st October 2006 to 17th March 2007 was measured by an automatic temperature datalogger 'thermo button' or 'i-button' (button-shaped thermometer) with the time interval of 15 minutes. The provider is Dallas Semiconductor. The datalogger was placed in a special, home-made shelter mounted on a metal pole which protected it from the unfavourable weather conditions (rainfall, frost, ice) and albedo. It was placed 2.5 m above the ground. The height of the measurements changed daily due to the changing of the snow cover height, but the datalogger was at least 1.5 m above the surface for almost the entire time. The air temperature data on the official meteorological stations Vogel and Kredarica were provided by the Meteorological Office of the Environmental Agency of the Republic of Slovenia (ARSO). Some climatic data were summarized also by Pristov et al. (1998).

The nomenclature source for the names of vascular plants is Mala flora Slovenije (Martinčič et al. 2007), except for *Scorzoneroides crocea* (Haenke) Holub = *Leontodon croceus* Haenke. Nomenclature of mosses follows Martinčič (2003) and names of syntaxa follow Aeschimann et al. (2004c), Grabherr (1993), and Ellmauer (1993). Description of geological conditions according to Jurkovšek (1987a, b).

Results

Landscape and ecological description of pasture Klek, a new locality of *Scorzoneroides crocea*

Pasture Klek (Zgornji Klek, 1556 m, owned by the community Podhom, and Spodnji Klek, 1522 m, owned by the community Blejska Dobrava) is a typical high-mountain pasture, which partly lies in a larger depression in the northern part of the wooded plateau Pokljuka in the eastern Julian Alps. The pasture is old and the first written records date back to the beginning of 16th century (Marušič 1987: 209). In the Middle Ages there were not only shepherds that dwelled on the pasture, but also miners who excavated the iron ore (Bizjak 2006: 90). The iron ore was being excavated as far back as the Roman times, in Late Antiquity. This was confirmed by archaeological excavations (Ogrin 2006: 103; Horvat 2006: 27; Bizjak 2004, 2006: 90). Pasture Klek on Pokljuka represents one of the possible mining reserves of Bled in the Roman Age (Ogrin 2006).

The pasture is still in use and every year calves, barren cattle, horses and sheep graze there.

Geological bedrock on pasture Klek is Triassic massive and layered dolomite and limestone, whereas Triassic massive and layered limestone prevails in its surroundings (Jurkovšek 1987a, b). The climate is montane with a mean annual temperature of 2–3°C (Pristov et al. 1998: 13) and a mean annual precipitation of around 2200 mm (Pristov et al. 1998: 26), of which at least a half falls as snow that stays on the ground for over 150 days (150 to 200 days). The vegetation period is therefore very short and lasts from May until September. *Scorzoneroides crocea* was found on Spodnji Klek in the lowest part of the depression (1510 m a.s.l.). The depression of Spodnji Klek is definitely a frost hollow, even though its dimensions are not as considerable

Table 1. Air temperatures during the calendar summer of 2006 in medium-mountain frost hollows on Mt. Komna (the Julian Alps) with a similar altitude to that of pasture Klek.

Frost hollow	Elevation	Number of days with temperature 0°C or lower	The lowest temperature
Planina Govnjač	1455 m	28	-9,4°C
Mrzla Komna	1592 m	40	-9,8°C

as those of other depressions on Pokljuka, in the Fužina pasturelands and on Komna (Ogrin et al. 2007: 203). The growth of *Scorzoneroides crocea* on Klek can be associated not only with soil conditions (see the next subchapter), but also with a distinctly colder local climate which gives the pasture the characteristics of a frost hollow. Investigations conducted by the Slovenian Meteorological Forum in the winter of 2006/2007 confirm the frequent occurrence of the atmospheric temperature inversion for the lowest part of the pasture. At the same altitude, these inversions may reach twenty degrees Centigrade and more, depending on the air temperature in the free atmosphere. Despite the mild winter with little snow and above-average monthly air temperatures (Ogrin 2007), the temperatures on pasture Klek dropped to -20°C and lower 18 times during the meteorological winter (between December and February). During a regular winter the air temperature may reach even about -40°C (Vertačnik et al. 2007). According to the meteorological station of the Meteorological Office of the Environmental Agency of the Republic of Slovenia (ARSO) on Mt. Vogel which has a similar altitude and the station on 1000 m higher Kredarica, these conditions heavily drop night and morning air temperatures (Fig. 2). Such low temperatures are not only the reason for on average colder months, but they are also one of the limiting factors that influence vegetation growth. According to the measurements conducted over several years in similar medium-mountain frost hollows, the frost occurs throughout the year, even during the warmest summer days (Tab. 1).

In very similar site conditions, in frost hollows on pastures Ovčarija and Za Grivo in the Fužina pasturelands (the eastern Julian Alps), on similar geological bedrock (Triassic limestone), *Pulsatilla vernalis* (also a character species of the class *Juncetea trifidi*) grows. These are its only localities known to date in the Julian Alps (Dakskobler et al. 2008).

Soil conditions on the site of *Scorzoneroides crocea* on pasture Klek

Predominant soils on Pokljuka are different forms of rendzinas (Leptosol) on limestones and dolomites or on glacial material (till, tillite). The soil on the mountain slopes on the northern edge of the plateau is very shallow, with a poorly developed humus-accumulative A horizon; the soil on extreme sites is lithosol (Lithic Leptosol). Moder rendzina with organic surface horizon directly on bedrock (Of-Oh-C) prevails on the mostly shady slopes of alpine valleys on the margins of the plateau. In surface depressions (dells, dolines), where mineral weathered material is being accumulated, the soil depth is deeper and allows the formation of well-developed mineral B horizon. The most common soil types of this class are brown soils on limestone and dolomite and eutric brown soils (Cambisol) – WRB (2006), CSES (1999).

On pasture Klek and its surroundings, soil depth and soil characteristics were investigated through test-drilling. On the margins of the pasture (the edge of the dell) we determined shallow moder

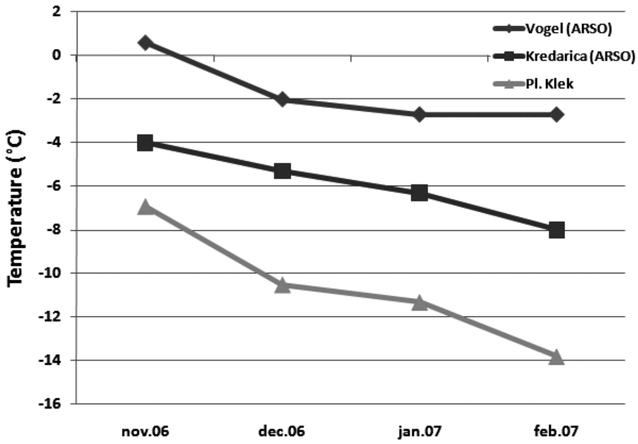

Figure 2. Average minimum monthly air temperature on Vogel (1535 m), Kredarica (2525 m) and pasture Klek in the period between November 2006 and February 2007.

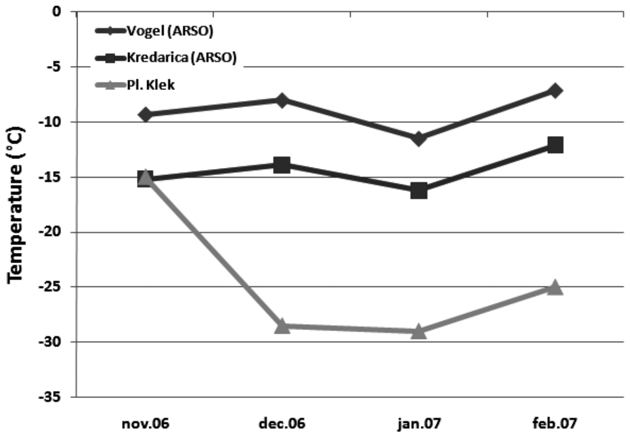

Figure 3. Absolute minimum monthly air temperature on Vogel (1535 m), Kredarica (2525 m) and pasture Klek in the period between November 2006 and February 2007.

rendzina which is consistent with the data on the soil map of Slovenia in scale 1:25000 (CSES 1999). In the locality of *Scorzoneroides crocea*, however, the soil is deeper and has a well-defined mineral horizon. Geological bedrock is dolomite limestone. The rock is heavily cracked, which points to the vicinity of a fault zone. The cracks are filled with clay and calcite. Fe-minerals (Fe-oxides and hydroxides) give the rock a red stain or coloration (Cambisol Chromic). The results of our analyses (Tab. 2) show that the humus-accumulative A horizon is 20–30 cm thick (C_{org} content > 1%). Organic matter content is considerable on the surface (25%) and decreases with depth, which indicates a natural sequence of horizons Ah, A, AB, Brz, C. Some parameters of physical and chemical soil analysis indicate also the leaching process. The process of displacement of the finest soil particles is manifested in the decrease of clay content in the upper four layers, while the extremely low soil pH value to the depth of 20 cm is indicative of the leaching of elements. Because of base cation release the soil reaction on dolomite limestone is either neutral

Table 2. Soil analysis on the site of *Scorzoneroides crocea* on pasture Klek.

Depth [cm]	pH	C_{org} [%]	$CaCO_3$ [%]	N [%]	C_{org}/N [%]	Sand [%]	Silt [%]	Clay [%]	CEC[1] [cmol(+)/kg]	EA[2] [cmol(+)/kg]	BS[3] [%]
0–5	4.10	14.50	0.00	1.20	12.13	5.65	46.24	48.12	12.67	5.14	59.42
5–10	4.09	6.15	0.00	0.49	12.53	7.41	59.29	33.30	8.40	5.21	37.92
10–20	4.36	2.89	0.00	0.22	13.17	9.37	61.79	28.84	3.76	2.58	31.37
20–30	5.77	1.64	0.80	0.14	11.62	9.61	65.66	24.73	5.35	0.07	98.78
30–40	7.21	0.30	36.75	0.07	4.10	30.65	36.00	33.35	11.39	0.00	100.00

[1] Cation exchange capacity
[2] Exchangeable acidity
[3] Base saturation

or, in upper humus-accumulative horizons, poorly acid to acid, especially due to the influence of humus acids; pH values lower than 4.5 are common only for soils on non-carbonate rocks or in soils leached of base cations. The base saturation (V value) in the upper three soil layers is low for soil on limestone and dolomite. Soils on the locality of *Scorzoneroides crocea* are therefore classified as slightly leached shallow brown soils on limestone and dolomite (Leptic Cambisol).

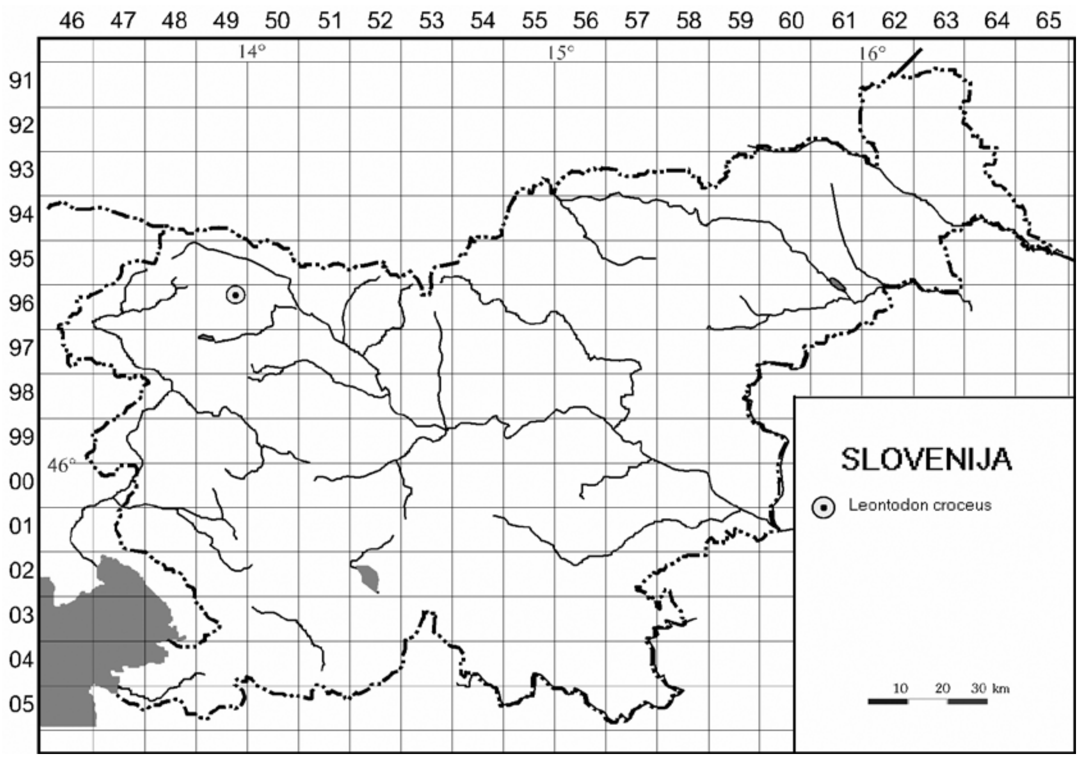

Figure 4. Distribution of *Scorzoneroides crocea* (= *Leontodon croceus*) in Slovenia.

Description of the new locality and phytosociological description of the sites of *Scorzoneroides crocea* on pasture Klek

Figures 4 and 5 show the distribution of *Scorzoneroides crocea* in Slovenia and a detailed location of its localities on pasture Klek.

Description of the locality:

9649/2 (UTM 33TVM23): Slovenia, the Julian Alps, Pokljuka, pasture Klek, Spodnji Klek, 1510 m a.s.l., pasture, slightly acid grassland (Tab. 3). Leg. & det. I. Dakskobler, A. Seliškar, B. Vreš, M. Culiberg & T. Čelik, 17. 7. 2009, Herbarium ZRC SAZU (SRC SASA).

Scorzoneroides crocea grows on a pasture, in the lowest frost hollow part of a large depression in the northern part of the Pokljuka plateau. A total of 39 species were recorded on two relevés situated about 50 metres apart. Species, characteristic for acidophilous grasslands of the classes *Calluno-Ulicetea* and *Juncetea trifidi*, prevail (sum of relative frequencies of these two groups is 41%, and together with acidophilous character species of spruce forests almost 49%). The proportion of diagnostic species of subalpine-alpine grasslands on carbonate bedrock (class *Elyno-Seslerietea*) is 20%. Other species growing on the pasture are diagnostic for basophilous pine forests, tall

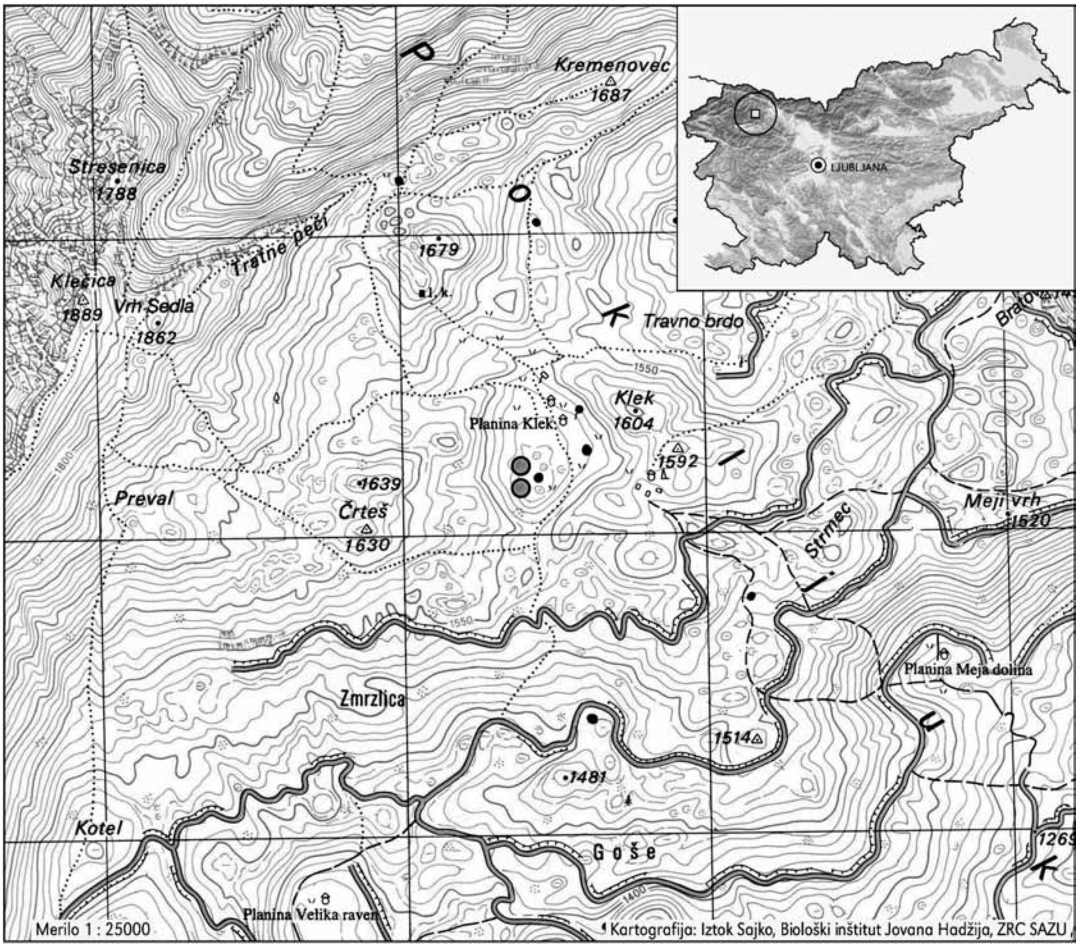

Figure 5. Localities of *Scorzoneroides crocea* on pasture Klek (Source: Topographical map RS 1:5000, GURS).

Table 3. Stands with *Scorzoneroides crocea* on pasture Klek (the Julian Alps).

Number of relevé		1	2	
Working number of relevé		226266	226267	
Altitude in m		1510	1510	
Aspect		E	SW	
Slope in degrees		2	1	
Parent material		K	K	
Soil		LBS	LBS	
Stoniness in %		0	0	
Cover in %: Herb layer	E1	100	100	
Relevé area	m^2	6	6	
Number of species		32	33	
Date of taking relevé		7/17/2009	7/17/2009	
Calluno-Ulicetea				Pr.
Nardus stricta	E1	3	3	2
Arnica montana	E1	1	1	2
Luzula exspectata	E1	1	1	2
Carex pilulifera	E1	1	1	2
Potentilla erecta	E1	1	1	2
Carex pallescens	E1	1	+	2
Gentiana pannonica	E1	1	+	2
Polygala vulgaris	E1	+	.	1
Luzula campestris	E1	.	+	1
Juncetea trifidi				
Antennaria dioica	E1	1	2	2
Anthoxanthum nipponicum	E1	1	1	2
Festuca nigrescens	E1	1	1	2
Scorzoneroides crocea (= *Leontodon croceus*)	E1	+	+	2
Campanula scheuchzeri	E1	+	+	2
Elyno-Seslerietea				
Polygonum viviparum	E1	+	1	2
Euphrasia picta	E1	+	+	2
Ranunculus carinthiacus	E1	+	+	2
Ranunculus montanus	E1	+	+	2
Thymus praecox subsp. *polytrichus*	E1	+	+	2
Lotus alpinus	E1	+	.	1
Selaginella selaginoides	E1	r	.	1
Heracleum austriacum subsp. *siifolium*	E1	.	+	1
Arabidetalia caeruleae				
Salix retusa	E1	.	+	1
Scheuchzerio-Caricetea fuscae				
Carex nigra	E1	+	1	2
Poo alpinae-Trisetalia				
Poa alpina	E1	+	+	2
Crocus albiflorus	E1	.	+	1
Molinio-Arrhenatheretae				
Agrostis capillaris	E1	+	+	2
Trifolium pratense	E1	+	+	2
Trifolium repens	E1	+	.	1
Festuco-Brometea				
Carex montana	E1	.	+	1
Mulgedio-Aconitetea				
Veratrum album subsp. *album*	E1	+	+	2
Hypericum maculatum	E1	.	+	1
Erico-Pinetea				
Juniperus alpina	E1	+	+	2
Erica carnea	E1	+	.	1
Vaccinio-Piceetea				
Vaccinium vitis-idaea	E1	1	+	2
Picea abies	E1	+	+	2
Vaccinium myrtillus	E1	.	1	1
Querco-Fagetea				
Anemone nemorosa	E1	2	2	2
Veronica officinalis	E1	r	.	1

Table 4. Groups of diagnostic species in the stands with *Scorzoneroides crocea* on pasture Klek (relative frequencies)

Calluno-Ulicetea	25
Juncetea trifidi	16
Elyno-Seslerietea	20
Arabidetalia caeruleae	1.6
Scheuchzerio-Caricetea fuscae	3.1
Poo alpinae-Trisetalia	4.7
Molinio-Arrhenatheretae	7.8
Mulgedio-Aconitetea	4.7
Erico-Pinetea	4.7
Vaccinio-Piceetea	7.8
Querco-Fagetea	4.7
Total	100

herbs, cultivated meadows (the influence of pasturing), moist snow beds, springs and other plant communities (Tab. 4). Such species composition indicates specific microclimatic, and especially edaphic conditions (leached soils) on carbonate bedrock, where grasslands from the class *Elyno-Seslerietea* generally prevail in the non-forest (subalpine and alpine) belt.

For the most part, phytosociologists classify colline-subalpine meadows with dominating mat-grass (*Nardus stricta*) into the order *Nardetalia* Preising 1949, which in turn is classified by some into the order *Calluno-Ulicetea* Br. Bl. et Tx. ex Klika 1948 (Ellmauer 1993), and by some into an independent class *Nardetea strictae* Rives Goday et Borja Carbonell 1961 (Theurillat et al. 1995, Aeschimann et al. 2004c). Subalpine-alpine acid grasslands with mat-grass (*Nardus stricta*) are commonly classified into the alliance *Nardion strictae* Br.-Bl. 1926 and class *Juncetea trifidi* Hadač 1946 (= *Caricetea curvulae* Br.-Bl. 1948). The first phytosociological table of *Nardus stricta* communities in Slovenia was published by Aichinger (1933: 134–135) for the *Nardus stricta* community (*Nardetum strictae* sensu auct.) in the Karavanke mountains (relevés are from both, Slovenian and Austrian slopes of this ridge; in modern terminology at least some of the relevés can be classified into the association *Sieversio-Nardetum strictae* Lüdi 1948; see also Grabherr 1993: 361–362). More recently, two associations have been researched and described with phytosociological tables: *Polygalo vulgaris-Nardetum strictae* (Preising 1953) Oberdorfer 1957 (Dakskobler 2005: montane belt in the submediterranean-prealpine part of Slovenia) and *Homogyno alpinae-Nardetum strictae* Mráz 1956 (Kaligarič & Škornik 2002; Škornik et al. 2006: altimontane and subalpine belts in silicate mountain ranges of northeastern Slovenia – Pohorje, Kozjak, Smrekovec, Košenjak). In the neighbouring Friuli Venezia Giulia (NE-Italy), Poldini & Oriolo (1997) published a table of the association *Polygalo vulgaris-Nardetum* (some of the relevés were made also in the southwestern foothills of the Julian Alps: Montemaggiore/ Breška gora, Joanaz/Ivanac), *Homogyno alpinae-Nardetum strictae* and even the association *Sieversio-Nardetum strictae* Lüdi 1948, which they classified into the alliance *Nardion strictae*. The stands recorded on pasture Klek are still in the forest belt. The land to the south of the pasture is dominated by the subalpine spruce forest (*Adenostylo glabrae-Piceetum* M. Wraber ex Zukrigl 1973 corr. Zupančič 1993 (= *Homogyno sylvestris-Piceetum* Exner in Poldini & Bressan 2007)).

Some of the relevés of this community from Klek were published by Zupančič (1999: Table 8). The northward and eastward slopes above the pasture, towards the Klečica ridge, are now mostly overgrown with a larch forest (*Rhodothamno-Laricetum deciduae* Willner & Zukrigl 1999), which is, however, at least in the belt just above the pasture (at about 1500–1600 m a.s.l.), probably a secondary, very long-continued stage on potential spruce sites (some of the relevés of these larch stands from pasture Klek were published by Zupančič & Žagar (2007)). A comparison of our relevés with *Scorzoneroides crocea* (Tab. 3) with relevés of similar grasslands with dominating mat-grass (*Nardus stricta*) indicates that they cannot be classified into the association *Sieversio-Nardetum* (nor into the alliance *Nardion strictae* and class *Juncetea trifidi*). More appropriate in our opinion is its classification into the association *Homogyno alpinae-Nardetum strictae*, alliance *Nardo-Agrostion* Sillinger 1933, order *Nardetalia* and class *Calluno-Ulicetea* (or *Nardetea strictae* sensu Theurillat in Aeschimann et al. 2004c). Diagnostic species of the association *Homogyno alpinae-Nardetum* in our relevés include *Veratrum album*, *Gentiana pannonica* (these two species are quoted as diagnostic, character or differential for this association by Škornik et al. (2006)), *Campanula scheuchzeri* and *Poa alpina* (quoted as differential for the association by Ellmauer (1993), and Poldini & Oriolo (1997)).

Discussion and conclusions

Scorzoneroides crocea is an East Alpine-Carpathian species previously unknown in the Southeastern Alps or Southern limestone Alps (which include the South-Tyrol Dolomites, the Gailtal, the Carnic, the Julian and the Kamnik-Savinja Alps and the Karavanke mountains – see e.g., Mayer 1946: 86, and Fischer et al. 2008: 125–126). Its new locality on pasture Klek in the eastern Julian Alps is, somewhat surprisingly, quite far from the previously known localities (the closest are in the eastern and northeastern part of Carinthia in Austria – Saualpe and Koralpe, see Hartl et al. 1992: 225 and our Fig. 1). Specific site conditions are presumably the key factor for its growth on pasture Klek. In the surface depression or dell with a cold and humid climate, mineral weathered material is being accumulated and a cambic (B) horizon may develop. In cambic soils, the finest soil particles and clay are being displaced into lower soil layers. Base cations are leached in the upper layers, so the soil there is quite acid (pH 4.10–4.36). These are the characteristics of shallow, leached brown soils on limestone and dolomite (Leptic Cambisol), which were determined on the site of the species studied.

Pasture Klek has been cleared in the subalpine spruce forest belt, so the meadows or pastures there are mainly secondary and their communities most often classified into the class *Elyno-Seslerietea*. Because of the local leaching of the soil on surfaces, where we have found *Scorzoneroides crocea,* the species of this class were not dominant. Instead, these parts of the pasture are dominated by the species of acid subalpine-alpine grasslands with mat-grass (*Nardus stricta*) from the classes *Calluno-Ulicetea* and *Juncetea trifidi* (= *Caricetea curvulae*). Regarding their floristic compositions, the recorded stands (Tab. 3) are most similar to the stands of the altimontane-subalpine association *Homogyno alpinae-Nardetum strictae*, into which it is temporarily classified.

The genus *Leontodon* (incl. genus *Scorzoneroides*) is rather difficult to determine and identification of species based solely on the leaf rosette is often uncertain. In addition, we were only rarely at the right place during the optimal flowering time, so we may have overlooked *Scorzoneroides crocea* during our research in the Julian Alps (On 30.6.2010, visiting pasture Klek again, we found *Scorzoneroides crocea* also on northwestern slopes of Spodnji Klek about 100 m northeast from the locality described in this paper, 1520–1530 m a.s.l., in the same community *Homogyno-Nardetum*). Similar is true for *Pulsatilla vernalis*, which used to be completely unknown in these mountains, above all because of its extremely early flowering. It grows on very similar sites to those of *Scorzoneroides crocea*, on locally slightly acid soils in the frost hollows of the Fužina pasturelands (Dakskobler et al. 2008). The detection of two new species characteristic for acidophilous subalpine-alpine grasslands in the predominantly calcareous Julian Alps in recent years is an incentive for their further, more detailed floristic mapping, especially on specific sites such as frost hollows.

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