Yu. KOBIV

Institute of Ecology of the Carpathians,
National Academy of Sciences of Ukraine
Kozelnytska St., 4, Lviv, 79026, Ukraine
e-mail: *rehablv@link.lviv.ua*

LIGULARIA SIBIRICA (L.) CASS. (*ASTERACEAE*) IN THE CHORNOHORA MOUNTAINS (UKRAINIAN CARPATHIANS): POPULATION-ONTOGENETIC PARAMETERS, MORPHOLOGY, TAXONOMY AND CONSERVATION

K e y w o r d s: Ligularia sibirica, *Carpathians, population, threatened species, conservation.*

Abstract

A new find of *Ligularia sibirica* is reported from the Chornohora Mts., which is the first record for that region and for Transcarpathia. Its exact location is given on the map. Ontogenetic characteristics, population parameters and some conservation considerations are presented. The population is highly vital, numbers about 1500 flowering individuals and seems to be the largest in Ukraine. The morphological data obtained prove that the plants from the Chornohora do not correspond to the description of *Ligularia bucovinensis* — an ambiguous «microspecies» that is supposed to occur in Ukraine.

Introduction

Thorough floristic studies in the Ukrainian Carpathians, and in the Chornohora Mts. in particular, started in the second half of the 19th century. Since that time the region attracted many botanists but a special tribute should be paid to H. Zapaiowicz who prepared a detailed compendium on the distribution of plant species, with indications of their locations, including altitude and exposition [41]. The bulk of later publications contain only rather scarce data on new botanical finds. This may lead to an assumption that further floristic research is useless in the region because it has been already comprehensively studied.

On the other hand, it is obvious that in comparison with the neighboring countries — Poland, Romania, Czech and Slovak Republics — which share the Carpathians with Ukraine, our knowledge on plant biodiversity is insufficient. This especially concerns rare and threatened species [29]. In order to classify their status properly according to the new IUCN criteria [27—28] we must know (1) exact location of populations, (2) their current condition and (3) dynamics. Unfortunately, we have such factual data only for a few threatened species and therefore the real level of threat to biodiversity remains improperly assessed. That does not allow preparing reliable Red Lists and Red Data Books. Obviously, the crucial problem

that impedes the development of conservation biology in Ukraine is the lack of exact primary objective data based on recent field research that may provide a basis for monitoring on populations of threatened species.

This article is an attempt to fill that gap concerning just one species, *Ligularia sibirica* (L.) Cass., in the Chornohora Mts. Along with other studies from the last decade, which give knew information on the biodiversity of the region [4—5, 7, 30—31], the presented results prove that there is much room for new floristic finds in the Chornohora in particular and in the Ukrainian Carpathians in general. The objective of the research was to provide data on the exact location of the newly found habitat, to describe ecological requirements, population parameters, biological characteristics, and the level of threat to the species in the region, and clarify its taxonomic status.

Ligularia sibirica sensu lato is a boreal Eurasian species [2]. The main area of its distribution lies in Russia, stretching from the taiga zone of its European part through Southern Siberia to the Far East [33]. Only isolated localities occur in the southwestern part of its range — in Ukraine, Poland, Romania, Czech and Slovak Republics, Hungary, Bulgaria, and Austria [19]. The species is regarded there as a relict of the earliest (pre-boreal) stage of the Holocene (post-glacial epoch) [38]. A few remote stations are also known from France [26]. Another isolated part of the range is confined to the Caucasus [33].

Ligularia sibirica is on the Bern Convention list of species, which are strictly protected in Europe [20]. Its habitats also merit conservation at the pan-European level, which is mentioned in the «Habitat Directive» of the Council of Europe [21]. The species is included into the Red Lists and Red Data Books of all Central-European countries adjacent to Ukraine [22, 36, 38, 40]. It has become extinct in Hungary and is classified as critically endangered (CR) in Poland, the Czech and Slovak Republics. The species is even considered as one of the rarest in the Polish flora and its population in the Tatra Mts. has already disappeared [36]. More localities occur in Romania and the closest to the Ukrainian border stations are known from the Marmarosh Mts. in Transylvania [35].

According to the herbarium and published data [1—2, 8, 16], in Ukraine *L. sibirica* sensu lato (including *L. bucovinensis* Nakai) was known from several localities in the western part of the country: Western Polissya (Volyn' Region), Lesser Polissya (on the border of Lviv, Rivne, and Ternopil' Regions), Roztochchya (Lviv Region), and Northern Podillya (Khmelnytskyi Region near Medzhybizh). These habitats are confined to calciferous moss bogs and wet meadows. Some of the populations have become extinct during the last century mainly because of large-scale melioration [1]. Reliable contemporary data on still existing populations of *L. sibirica* proved by rather new herbarium specimens and publications [2] refer only to a few localities in Lesser Polissya (Zdolbuniv and Ostroh Districts, Rivne Region). The species is listed in the Red Data Book of Ukraine as *L. bucovinensis* and is assigned to the first (highest) category of threat [1].

A few years ago *L. sibirica* was also discovered in the Ukrainian Carpathians in two closely located stations at the headstreams of the White Cheremosh River

in Chernivtsi Region [15]. That most interesting find from the Chyvchyny Mts. was made about 60 km to the south-east from the site described in this paper.

Some confusion was caused by misidentification of plants from southwestern Podillya, which actually belong to *Ligularia glauca* (L.) O. Hoffm. (in Soviet literature plants from Ukraine are known as *L. carpatica* (Schott, Nyman & Kotschy) Pojark., a taxon supposedly based on a few very inconsistent characters). That concerns a herbarium specimen (*KW* #025748) from a xerophilous steppe site near Tlumach in Ivano-Frankivsk Region, originally identified as *L. bucovinensis*. This misidentification influenced some publication, e. g. in the «*Identification Manual on Plants of the Ukrainian Carpathians*» [3, p. 303] the figure for *L. bucovinensis* in fact depicts *L. glauca*, which has ovate leaves and a very short pappus.

Material and Methods

The results presented here were obtained during field research in 2001, when the survey of streams in the Chornohora Mts. was performed in search for calcicole plants. Questioning of native people about so-called «lime streams» was very helpful for that purpose.

The density of the population and its structure were estimated on two 0.5 × 10 m^2 transects [12, 25]. Their location was chosen with regard to the mosaics of vegetation [24].

Much information on life history of the species was obtained through digging out individuals and examining their subterranean organs [11, 13, 17, 25]. A dozen of young individuals were transplanted to the Botanical Garden of I. Franko Lviv National University and to the author's garden in Lviv for further observations on their development.

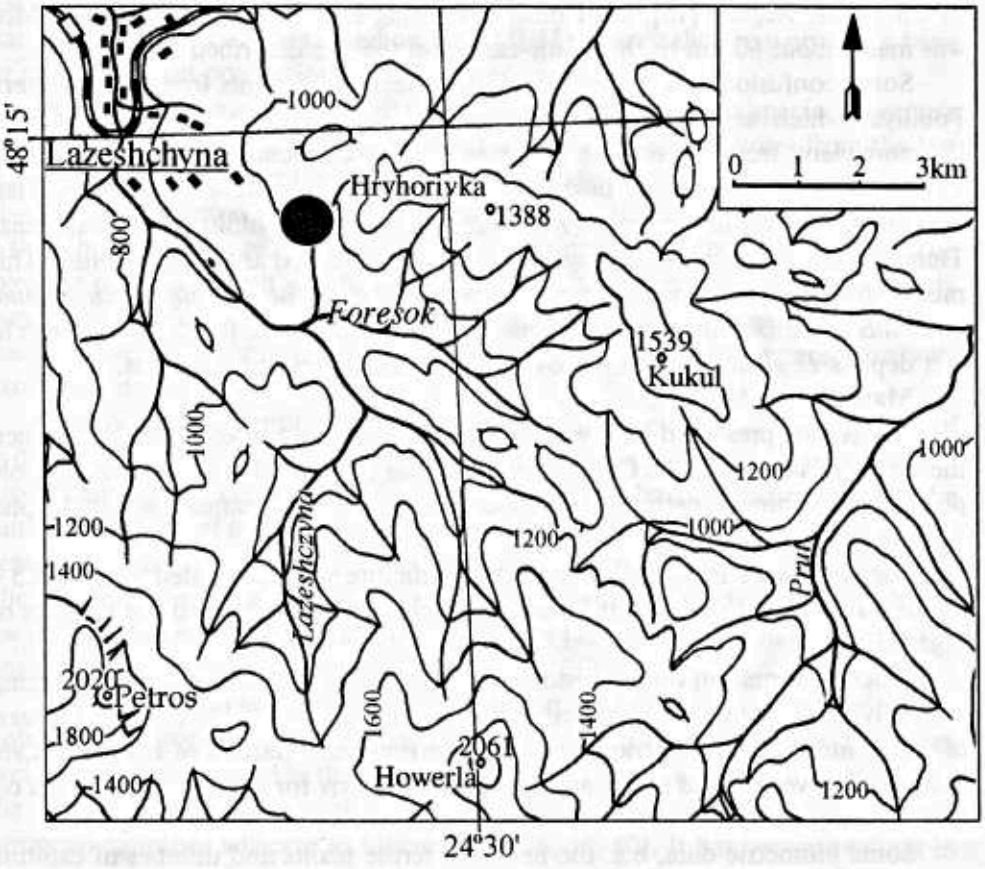
Some biometric data, e.g. the height of fertile plants and number of capitula per stem were obtained from 20 individuals *in situ*, while the rest of presented parameters refer to herbarized material (15—20 measurements).

Species abundance was evaluated according to the grades of Braun-Blanquet's scale [18] referring to the whole locality. However, since vegetation there was not uniform and was represented by several associations, these results cannot be treated in terms of a phytosociological relevй in the strict sense.

The collected specimens are deposited at the Herbarium of the M.G. Kholodny Institute of Botany (*KW*) and in the Herbarium of the I. Franko Lviv National University (*LW*).

Results

A large population of *L. sibirica* was discovered in the place of Tysovatyi situated on the 9th parcel in the 17th sector of Lazeshchyna Forestry (Fig.). It belongs to Rakhiv District of Transcarpathian Region. The habitat is located on the southern slope of the Hryhorivka-Kukul mountain range that runs almost parallel to the main Chornohora Range. The locality lies within 980—1010 m above sea level at the sources and along the upper part of two interflowing streams. The population makes a forked 150-metre long strip along the streambed. The stream is calciferous and its bed and banks are covered with a whitish layer of travertine — a calcite mineral



Location of *Ligularia sibrica* (L.) Cass. Jn the Chornohora Mts. Symbols indicate: ● — the species locality

of secondary origin formed due to sedimentation of $CaCO_3$ from water. The soil is alkaline with the pH (H_20) value ranging within 7.65—7.82. The slope is rather gentle with about 5° mean angle of inclination.

Vegetation covers 40—100 % and *L. sibirica* makes up about 7—8 %. Some sites near the streambed are barren and covered with stony screes. Mossy patches are also common at the stream sources. The habitat is situated mostly in the 60-year old secondary spruce forest established in the beech forest zone. However, the lower part of the population extends into the clear-cut with herbaceous vegetation. The following species of vascular plants with corresponding grades of abundance were registered at the locality: *Ligularia sibirica* — 2, *Abies alba* L. — +, *Acer pseudoplatanus* L. — +, *Aconitum moldavicum* L. — +, *Adenostyles alliariae* (Gouan) A. Kern. — +, *Caltha laeta* Schott, Nyman & Kotschy — 2, *Carex flacca* Schreb. — +, *Carex flava* L. — 1, *Carex pendula* Huds. — 2, *Carex sylvatica* Huds. — +, *Cirsium oleraceum* (L.) Scop. — 1, *Cortusa matthioli* L. subsp. *sibirica* (Andrz.) E.I. Nyárády — 1, *Crepis paludosa* (L.) Moench — +, *Dactylorhisa majalis* (Rchb.) P.H. Hunt & Summerh. — +; *Daphne mezereum* L. — +, *Deschampsia cespitosa* (L.)

P. Beauv. — 2, *Doronicun austriacum* Jacq. — +, *Equisetum sylvaticum* L. — 2, *Fagus sylvatica* L. — +, *Galium schultesii* Vest — +, *Geranium robertianum* L. — +, *Juncus effusus* L. — +, *Linum catharticum* L. — +, *Myosotis nemorosa* Besser — +, *Petasites albus* (L.) P. Gaertner — 2, *Picea abies* (L.) H. Karst. — 2, *Salix silesiaca* Willd. — +, *Scirpus sylvatica* L. — +, *Symphytum cordatum* Waldst. & Kit. ex Willd. — +, *Valeriana tripteris* L. — +, *Veronica beccabunga* L. — 1; and bryophytes: *Brachytecium rutabulum* (Hedw.) B., S. & G. — 2, *Bryum torquescens* B. & S. — +, *Cirriphyllum piliferum* (Hedw.) Grout — +, *Cratoneuron commutatum* (Hedw.) G. Roth — 3, *Plagiomnium undulatum* (Hedw.) T. Kop. — 1, *Thuidium recognitum* (Hedw.) Lindb. — +. Because vegetation in the locality is not homogenous, its different patches can be related to several syntaxonomic entities belonging mostly to hygrophytous orders — *Cratoneurion commutati* W. Koch, *Calthion* R. Tx. and *Adenostylion alliariae* Br.-Bl.

Phenological development, life history and population parameters. *Ligularia sibirica* is a short-rhizomatous herbaceous perennial. Its sterile shoots form rosettes of long-petiolate leaves. Leaf rosettes begin to develop in May and flowering stems — in late June. Flowering usually starts in the first half of July and lasts for about 2 weeks. Flower development is acropetal. Seeds ripen in late July-August. Flower stems die off by that time, but most of them remain erect till winter, still carrying a significant part of seeds, so that dissemination lasts from August till December. Leaf rosettes stop their vegetation in October. Though achenes have pappus and are adapted to anemochory, the bulk of seeds land close to the parental plants. Good moistening and light are needed for successful germination. Such conditions are provided mostly on the patches of moss or bare soil. As the stream bed is shallow and not distinct in its upper part, water flow often changes its way, leaving numerous bare sites which get covered with moss later. The area of such sites is about 0.02—0.05 m^2 where up to 10—15 seedlings of *L. sibirica* occur. They form so-called nurseries, which present most favorable conditions for germination and further development of the seedlings. Later on, after some natural thinning, they form cohorts of young and then mature individuals of the same age with extremely high density. Such a low rate of intraspecific competition seems to be intrinsic also for some other hygrophytic species, e.g. *Cortusa matthioli* subsp. *sibirica, Swertia perennis* L. subsp. *alpestris* (Baumg. ex Fuss) Simonk., and *Angelica archangelica* L.

The seedlings of *Ligularia sibirica* appear in autumn or in spring. They have oblong-obovate cotyledons, 11.0—12.5 × 4.5—5.0 mm in size, on petioles 20—35 mm long. Hypocotyl is ca. 1.5 mm in diameter. First leaves are reniform, often toothless, with thin indumentum on the edge and along the veins. Like cotyledons, they are glandular. Subsequent leaves are more densely covered with indumentum on their lower surface. Laminae are sinuate, with small and scarce dark teeth. The root system becomes very branched at the earliest stage of its development and the primary root loses its leading role. At that time the rhizome begins to develop with numerous adventitious roots, which form clusters gathered in verticils. After about 3 months of development the seedlings have leaves 2.5—4.0 cm long and wide on petioles 6—10 cm long. The rhizome is about 3 mm thick.

Second-year immature individuals have rosettes of 2—3 leaves (5—10 cm in diameter) with 15—25 cm long petioles. Rhizomes are 4—8 mm in diameter.

Third-year sterile individuals have much larger rosettes of 4 leaves (7—17 cm in diameter). Petioles are 20—35 cm long, rhizomes are 12—15 mm thick.

Fourth-year individuals are usually still sterile. At that period of their life history they have the largest leaves (up to 30 × 25 cm). Petioles reach 55—60 cm. Rhizomes increase as well, reaching ca. 20 mm in diameter.

Flowering usually begins on the fifth year when vitality of an individual is sufficient to produce a flowering stem. It develops from a lateral bud on the rhizome, while its apical part forms a leaf rosette. Thus, a typical fertile individual has two shoots — fertile and sterile — closely situated on the rhizome. Rosettous leaves are smaller than in forth-year sterile individuals, whereas rhizomes are thicker — 22—32 mm in diameter. Flowering function persists for 2—4 subsequent years. Most vital fertile plants have two sterile rosettous shoots in addition to a flowering stem. This initiates branching of the rhizome and its consequent fragmentation next year, i.e. vegetative reproduction. Rhizomatous growth is very slow and its annual rate makes 14—18 mm. The rhizome constricts across the internode and its old segment dies off; therefore, each individual typically has only one or two youngest nodes with thick clusters of adventitious roots on them. One-year cessation in flowering is atypical though rarely happens in fertile individuals and indicates temporary decrease in their vitality. Very stunted post-fertile (senile) individuals occur as well, but their percentage is very low (about 3 % within the adult group). Thus, the life span typically lasts for 6—9 years. It is unidirectional and does not provide any rejuvenation. Off-site observations on young plants showed that long-lasting unfavorable conditions may result in the so-called Oscar syndrome, when an individual maintains immature characters for several years without any visible progression in its development [37].

Though vegetative reproduction sometimes occurs, it does not increase the longevity of the live span significantly. The population is maintained mostly by means of seed reproduction.

The population area is 2000—2500 sq. m. The number of flowering individuals is about 1500. Their average density is ca. 0.7 though it may reach up to 12 per m^2. Percentage of flowering individuals within the adult group is 34.5±2.8 %. The ratio between seedlings and adult individuals is 1.8.

Morphological characters of fertile plants. Rhizome short, 20—30 mm thick, covered with dense string-like brown-yellow adventitious roots. Stem 75—125 cm tall, erect, hollow, purplish, sulcate and hairy, especially in the upper part, 5—9 mm in diameter. Basal leaves 8—19 × 7—17 cm, triangular-subsagittate or cordate, dentate to sinuate, grayish and hairy beneath and along the margins. Their petioles 1.2—2.7 times as long as laminae, sheathing, thin and hollow. Upper cauline leaves serrate, subsessile, with broad sheaths. Capitula 27—35 mm in diameter, the upper ones smaller than the lower ones. Inflorescence a lax 14—30 mm long raceme, formed by 10—29 capitula on peduncles 5—80 mm long (longest in the lower part). Bracts oblong-lanceolate, 13—28 mm long.

Inflorescence rarely branched in its lowest part. Involucre campanulate, 13—16 mm long, divided to 1/3—1/2 of its length. Involucral bracts 3.5—6.0 mm wide, ovate-lanceolate, acute or rounded, with dark tips. There are also two thin, linear supplementary bracts at the base of each capitulum about as long as the involucre. Peduncles and involucre densely hairy, sometimes arachnoid. Outer florets ligulate and pistillate; inner ones tubular and bisexual. Ligules 6—9 per capitulum, bright yellow, 9—19 × 4.5—5.5 mm, oblong-obovate, with rounded or denticulate tips. Tubular florets 13—31 per capitulum, pentamerous, with corolla 9.0—9.5 mm long. Wider upper part of corolla 4.3—4.7 mm long, tubular-campanulate to campanulate, with teeth 1.0—1.25 mm long. Its narrowed lower part slightly longer, ca. 4.5—5.0 mm. Stigmas in both ligulate and tubular florets divaricate, with revolute parts ca. 2.5 mm long. Achenes 4.0—5.5 mm long, narrowly cylindrical, ribbed; pappus brown-white, 6.5—8.0 mm long.

Taxonomic status. There is much confusion in the taxonomic position of representatives of the genus *Ligularia* Cass., which occur in Ukraine. In the 1950—1960 Soviet botanists Y. Minderova [8] and A. Poyarkova (Pojarkova) [10] have delimited several microspecies within *L. sibirica* s. l. according to the monotypic species concept, which was dominant in the Soviet Union in those times. Thus, after examining old herbarium specimens from Volyn', Y. Minderova [8] described a new species, *L. ucrainica* Minder., and claimed that its range covers the northwestern part of Ukraine. That population is already extinct [1]. Later on A. Poyarkova in the «Flora of the USSR» classified all plants from Ukraine, as well as specimens from Poland and Romania, as *L. bucovinensis* [10]. Then in the «Flora of the Ukrainian SSR». Minderova accepted that and agreed that *L. ucrainica* is merely a synonym for *L. bucovinensis* [9]. In the opinion of these authors, the latter differs from *L. sibirica* in the height and thickness of its stem, shape of leaves and their margins, indumentum, number of capitula and ligulate and tubular florets, size of ligules, and several other minor characters [8—10]. However, these traits overlap and seem to be elusive and not qualitative. For example, according to A. Poyarkova, one of the crucial distinguishing characters of *L. sibirica* sensu stricto, which is even included into the identification key in the «Flora of the USSR» is: «leaves (in the herbarium) thin» [10, p. 796], while further text says that «in the dried state leaves thin, rarely rather thick» [10, p. 807]. In addition to the problematic value of such characters, some of them do not correspond to plants occurring in Eastern Europe. That is why the authors who prepared treatments of *Ligularia* in European [19, 26] and regional floristic compendia for the East-European countries neighboring to Ukraine were very skeptical about the validity of *L. bucovinensis*. Being aware of considerable variability within *L. sibirica* sensu lato, they are unanimous that plants occurring in Central and Eastern Europe, including Ukraine, do not merit the status of a separate species [23, 32, 35]. For example, E.I. Nyárády [35], who analyzed the vast material from Romania and the Tatra Mts., came to the conclusion that the plants from that territory do not correspond to the description of *L. bucovinensis* provided by A. Poyarkova [10]. That Romanian author pointed out that all these plants can be classified as *L. sibirica*, but some of them belong to

Table 1. **Morphological characters of plants from the Chornohora population in comparison to *Ligularia* A. Poyarkova [10]**

Character	Chornohora population	Y. Minderova
		L. sibirica
Height, cm	75—126.5	30—115
Diameter of stem, mm	5—9	7—10
Number of capitula	10—29	≤28
Number of ligular florets	6—9	10-11
Length of ligule, mm	9—19	—
Width of ligule, mm	3—5.5	—
Number of tubular florets	13-31	20—28
Proportion between upper and lower parts of tubular florets	Lower part longer	Lower part shorter
Shape of upper part of tubular florets	Tubular-campanulate to campanulate	Campanulate
Shape of stigma	Parts of stigma not flattened, uniform or slightly clavate	Parts of stigma flat, uniform
Length of achene, mm	4.0—5.5	ca. 4
Length of pappus	6.5—8.0 mm; 1.2—1.5 times longer than achene	Slightly longer than achene

Table 2. **Average parameters of flowering individuals of *Ligularia sibirica* Cass. from the Chornohora**

Height, cm	Diameter of stem, mm	Length of basal leaf, cm	Width of basal leaf, cm	Length of petiole, cm	Length of inflorescence, mm
102.0±3.5	7.3±0.4	13.6±0.6	12.3±0.6	22.7±1.8	20.9±1.2

two forms with atypical indumentum: f. *pubicaulis* J. Kell and f. *araneosa* (DC.) E. Pop. Thus, in spite of the fact that the typical specimen of *L. bucovinensis* came from Southern Bucovina from the locality near Romanian town of Compulung [34] (which is situated only about 70 km from the border with Ukraine), even the local Romanian botanists did not recognize the existence of such a taxon [35]. That is why classifying plants from Ukraine as *L. bucovinensis* seems to be still more problematic and modern Ukrainian authors have also expressed reasonable doubts regarding the status of that species [15].

Table 1 enables to compare morphological characters of fertile plants from the Chornohora population with those stated by Y. Minderova [8—9] and A. Poyarkova [10] for both *Ligularia bucovinensis* and *L. sibirica*. The most noticeable inconsistency between our plants and *L. bucovinensis* in the sense of the mentioned authors concerns their height, stem diameter, and number of capitula. The average values for the Chornohora plants are much higher than it could be supposed for *L. bucovinensis* in the sense of the above Soviet authors (Table 2). The same considerations have been expressed by some authors with regard to plants from Romania [35], Poland [32], and the Czech and Slovak Republics [23].

The minor size of some *Ligularia* specimens in Ukrainian herbaria, which have a series of such interrelated characters as small height, thin stem, low number of capitula etc., might refer to the fact that the collectors preferred atypically small

***sibirica* (L.) Cass. and *L. bucovinensis* Nakai according to Y. Minderova [8, 9] and**

(1957, 1962)	A. Poyarkova (1961)	
L. bucovinensis	*L. sibirica*	*L. bucovinensis*
30—95	30—125	30—75(100)
5—7	≥10	2.5—5.0
7—10(18)	(5)10—52	(5)7—20
6—8	7—8(11)	6—8
—	(10)14—17(20)	13—17
3.2—4.6	3—5	2.5—4.0
≤24	(18)23—32	20—24
Lower part longer	Lower part shorter	Lower part longer
Campanulate	Tubular-campanulate	Oblong-campanulate
Parts of stigma flat, with widened tips	Parts of stigma with slightly widened tips	Parts of stigma with slightly wider flattened tips
4—5	5—6	4—5
1.5—2.0 times longer than achene	As long as achene	Slightly longer than achene

populatio

Number of capitula per stem	Length of ligule, mm	Number of ligular florets per capitulum	Number of tubular florets per capitulum
18.9±1.5	14.2±0.7	7.6±0.2	21.3±1.3

individuals, which are easier to herbarize. Anyway, the small size of plants does not seem to be sufficient to categorize them as a separate species. Other traits (edge and shape of the leaf blade, pubescence, color of the stem, number of florets and ligules etc.) suggested by A. Poyarkova [10] and Y. Minderova [8—9] as discriminant between *L. sibirica* and *L. bucovinensis* in fact are variable even within the Chornohora population. The only reliable character in which plants from Ukraine and adjacent territories differ from those from some regions of Siberia, which, according to A. Poyarkova, are typical for *L. sibirica* sensu stricto is the proportion between the upper (wider) and lower (narrower) parts of the corolla in tubular florets. While in Ukrainian plants this ratio varies within 1.05—1.2 in favor of the lower part, in certain regions of Siberia and European Russia it is inverse with the upper part slightly longer. However, this ratio is rather variable even within the Chornohora population where it makes 1.05—1.15. It also varies throughout the whole range of *L. sibirica* sensu lato and plants with a shorter upper part of the corolla occur in the Caucasus and specimens with both parts equal — in other regions of Siberia and in the Far East [10]. Various modifications of this proportion between the upper and lower parts of tubular florets in combination with different expressivity of some of the mentioned indistinct and overlapping morphological traits were used by Y. Minderova [8] and A. Poyarkova [10] for delimitation of several microspecies within *L. sibirica* sensu lato. Another ratio between the length of the pappus and

achene, which is rather high (1.2—1.5) for the Chornohora population (Table 1), also varies throughout the range of *L. sibirica* sensu lato [10].

In fact, the above authors' treatment of *L. bucovinensis* is misleading because it differs significantly from T. Nakai's original description of that species [34]. First, his protologue contains no evidence of the small size of *L. bucovinensis*. Thus, T. Nakai's statement that «stem is 1 m tall with inflorescence 17 cm long» [34, p. 135] shows that the plant is not small at all, which contradicts Y. Minderova's [8, 9] and A. Poyarkova's [10] indications.

Second, unlike these authors, T. Nakai [34] pointed out that the distinguishing characters for *L. bucovinensis* in comparison to *L. sibirica* are: (I) a hirsute stem with patent multicellular hairs and (II) triangular-sagittate leaves. The examination of indumentum on many herbaruim specimens of *L. sibirica* sensu lato showed that in fact they have two types of hairs: (I) thin and straight, mostly short; (II) thicker, longer, multicellular, sometimes articulate and curly. Actually, both types occur on all the specimens all over the vast range of *L. sibirica*, but their density is variable. Thus, in plants from Europe the stem, especially in its upper part, is rather densely covered with multicellular curly hairs. This concerns plants from Ukraine, Poland and Russia, but most hairy specimens come from some regions of Romania. Apparently, they may be classified as *L. sibirica* f. *araneosa* (DC.) E. Pop, according to E.I. Nyárády [35]. As regards the shape of basal leaves, it also varies significantly even within the same individual, but in general plants from Europe have leaves mostly triangular-sagittate vs. cordate-subsagittate from Western Siberia. Nevertheless, that character is too variable and hardly can be used as a reliable discrimination tool.

Third, T. Nakai [34] considered that *L. bucovinensis* is closely related to *L. fisheri* (Ledeb.) Turch., which occurs in the Far East, while A. Poyarkova [10] attributed these species to different intrageneric series — respectively *Racemosae* Kitam. and *Speciosae* Pojark. for considerable distinctions in the proportion between the length of pappus and ligular florets. On the basis of that ratio and morphology of ligular florets (e.g. stamina protruding vs. inserted into the corolla) plants from Ukraine are obviously more affined to *L. sibirica* than to *L. fisheri*. Such taxonomic approach better reveals intrageneric diversity in *Ligularia*. Apparently, T. Nakai's opinion on the affinity between *L. bucovinensis* and *L. fisheri* is based merely on similar indumentum on the stem.

Finally, according to T. Nakai [34] in *L. bucovinensis* the upper part of the corolla exceeds the lower (proportion makes 4 to 3 mm), which in the sense of Y. Minderova [8, 9] and A. Poyarkova [10] is characteristic for *L. sibirica* sensu stricto. However, plants from Ukraine have inverse proportion of that ratio. Its taxonomic value seems to be rather low and varies even throughout Eastern Europe. Except for that character, T. Nakai's description of *L. bucovinensis* in general corresponds to plants from Ukraine and from the Chornohora in particular, but this also concerns almost all the entity of plants from Europe including another ambiguous «microspecies» — *L. lydiae* Minder., which according to Y. Minderova [8] and A. Poyarkova [10] is confined to European part of Russia.

According to modern concepts, a polymorphic species may have a set of variable characters of minor taxonomic value. If they form some conspicuous consistent patterns (e.g. geographical), in which entities differ from each other, such differences may be used to delimit infraspecific categories, such as subspecies, varieties or forms [39]. Referring to *Ligularia sibirica*, such an attempt was made by L.P. Sergiyevskaya, who described several its varieties in Western Siberia [14]. The foregoing material shows that there is no reasonable evidence for clear delimitation of Ukrainian and adjacent populations from the whole entity of plants representing *L. sibirica* sensu lato throughout their vast Eurasian range. Probably, in the future, after more profound taxonomic analyses of that polymorphic species, including patterns of taxonomically significant characters and their distribution, it might be possible to recognize one or more infraspecific taxa occurring in Ukraine.

Conclusion

Conservation considerations. The described above population of *L. sibirica* is the first find of this species in the territory of the Chornohora Mts. and the whole region of Transcarpathia. Along with the latest I. Chorney's data on its localities in the Chyvchyny Mts. [15], this is the second report on *L. sibirica* from the Ukrainian Carpathians. The species habitats are restricted to calciferous sites, which are very rare in the region, because the Ukrainian Carpathians are built mostly from sandstone flysch. That is why scarce limestone outcrops or inclusions are always particularly interesting in terms of their flora, which often includes rare and threatened species. Historically, floristic investigations on calcicole species were focused mostly on rocky habitats, while their hygrophytous localities remained almost unstudied [6]. Nevertheless, moist calciferous habitats are remarkable for their biodiversity. A number of endemic, relict, threatened and rare species occur there, e. g. *Saussurea porcii* Degen, *Festuca porcii* Hack., *Carex buxbaumii* Wahlenb., *C. davalliana* Smith, *Swertia perennis* subsp. *alpestris*, *Cortusa matthioli* L. subsp. *sibirica* et al. [5—6].

The Chornohora population of *L. sibirica* seems to be the largest in Ukraine and has a high vitality. No threat to its survival in the nearest future has been noticed in contrast to its lowland localities, which are critically endangered or already extinct [1]. Nevertheless, the described habitat is valuable for its biodiversity. In addition to *L. sibirica*, some other notable species occur here, e. g. *Cortusa matthioli*. Because of that it is recommended to protect the site, which could be most effectively provided by including it into Carpathian Biosphere Reserve. Conservation of that area is still more reasonable because the catchment basin of the Lazeszchyna stream with its tributaries is the only area near Hoverla and Petros Mts. that does not have the reservation status, though contains a number of localities of threatened and rare species (e. g. *Primula halleri* J.F. Gmelin, *Rhodiola rosea* L., *Swertia perennis* subsp. *alpestris*, *Pinguicula alpina* L., *P. vulgaris* L., *Carex buxbaumii*), especially in its upper part.

1. *Андрієнко Т.Л.* Язичник буковинський // Червона книга України. Рослинний світ / Під заг. ред. Ю.Р. Шеляга-Сосонка. — К.: УЕ, 1996. — С. 266.
2. *Андрієнко Т.Л., Антонова Г.М.* Флористичні знахідки на Ровенщині // Укр. ботан. журн. — 1986. — **43**, № 4. — С. 97—101.

3. *Визначник* рослин Українських Карпат. — К.: Наук. думка, 1977. — 434 с.
4. *Волгин С.А., Сычак Н.Н.* Манжетки (*Alchemilla* L., *Rosaceae*) Украинских Карпат // Бюл. Моск. о-ва испытателей природы. Отд. биол. — 1992. — **97**. — С. 78—91.
5. *Данилик І.М., Антосяк В.М. Carex davalliana* Smith (*Cyperaceae*) — новий вид флори високогір'я Українських Карпат // Укр. ботан. журн. — 1997. — **54**, № 3. — С. 275—278.
6. *Кобів Ю.* Приструмкові оселища рідкісних кальцефільних видів рослин у лісовому поясі Чорногори // Національні природні парки: проблеми становлення та розвитку. Матли міжнар. наук.-практич. конфер. — Яремче, 2000. — С. 142—145.
7. *Кобів Ю.Й., Нестерук Ю.Й.* Унікальна популяція *Callianthemum coriandrifolium* Reichenb. (*Ranunculaceae*) у Чорногорі (Українські Карпати) // Укр. ботан. журн. — 1996. — **53**, № 3. — С. 218—223.
8. *Міндерова Є.В.* Рід *Ligularia* Cass. у флорі Європейської частини СРСР // Укр. ботан. журн. — 1957. — **14**, № 1. — С. 44—53.
9. *Міндерова Є.В.* Рід 905. Язичник — *Ligularia* Cass. // Флора УРСР. — К.: Вид-во АН УРСР, 1962. — Т. 11. — С. 369—371.
10. *Пояркова А.И.* Род 1564. Бузульник — *Ligularia* Cass. // Флора СССР. — М.; Л.: Изд-во АН СССР, 1961. — Т. 26. — С. 778—857.
11. *Работнов Т.А.* Методы определения возраста и длительности жизни у травянистых растений // Полевая геоботаника. — М.; Л.: Изд-во АН СССР, 1960. — Т. 3. — С. 249—278.
12. *Работнов Т.А.* Определение возрастного состава популяций видов в сообществе // Полевая геоботаника. — М.; Л.: Наука, 1964. — Т. 3. — С. 132—145.
13. *Серебряков И.Г.* Морфология вегетативных органов высших растений. — М.: Сов. наука, 1952. — 315 с.
14. *Флора* Западной Сибири / Ред. Б.К. Шишкин, Л.П. Сергиевская. — Вып. XI. — Томск: Изд-во Томск. гос. ун-та, 1949. — С. 2625—3070.
15. *Чорней І.І. Ligularia bucovinensis* Nakai (*Asteraceae*) — новий вид для флори Українських Карпат // Укр. ботан. журн. — 1999. — **56**, № 1. — С. 19—21.
16. *Шмальгаузен И.* Флора Средней и Южной России, Крыма и Северного Кавказа. — Т. 2. — К.: Тип. И.Н. Кушнерова и К., 1897. — 762 с.
17. *Bell A.D., Tomlinson P.B.* Adaptive architecture of rhizomatous plants // Bot. J. Linn. Soc. — 1980. — **80**. — P. 125—160.
18. *Braun-Blanquet J.* Pflanzensoziologie. — 2 Aufl. — Wien: Springer-Verlag, 1951. — 581 p.
19. *Chater A.O. Ligularia* Cass. // Flora Europaea. — Vol. 4. — Cambridge; New York; Melbourne: Cambridge Univ. Press, 1976. — P. 205.
20. *Convention* on conservation of European wildlife and natural habitats. Appendix 1 of May 1999: Strictly protected flora species. — Bern, 1999. — 18 p.
21. *Council* Directive 92/43/EEC of May 1992 on the conservation of natural habitats and wildfauna and flora. Annex II (b). Plants. — Strasbourg. — P. 32—50.
22. *Dihoru G., Dihoru A.* Plante rare, periclitate şi endemice in flora Romaniei — Lista Roşie // Acta Botan. Horti Bucurestiensis. — 1994. — S. 173—197.
23. *Dostál J.* Nová květena ČSSR. — T. 2. — Praha: 1989. — S. 765—1548.
24. *Greig-Smith P.* Quantitative plant ecology. — 2 ed. — London: Butterworth, 1964. — 256 p.
25. *Harper J.L.* Population biology of plants. — New York; London: Academic Press, 1977. — 592 p.
26. *Hegi G.* Illustrierte Flora von Mitteleuropa. — B. 6(2). — Berlin; Hamburg: Verlag Paul Parey, 1979. — 1480 s.
27. *IUCN* Red List Categories. — Gland: IUCN, 1994. — 21 p.
28. *IUCN* Red List Categories and Criteria: Version 3.1. — Gland; Cambridge: IUCN Species Survival Comission, 2001. — 30 p.
29. *Kobiv Y.* Need for inventory of populations of threatened plant species in the Chornohora // Proceedings of the International Scientific-practical Conference. — Rakhiv: Carpathian Biosphere Reserve, 1997. — P. 91—93.
30. *Kobiv Y. Cortusa matthioli* L. (*Primulaceae*) in the Chornohora Mts (Ukrainian Carpathians): distribution, ecology, taxonomy and conservation // Fragm. Flor. Geobot. — 1999. — **44**, № 2. — P. 355—374.
31. *Kobiv Y., Nesteruk Y. Pedicularis oederi* (*Scrophulariaceae*) in the Chornohora Mts (Ukrainian

Carpathians): distribution, biology, ecology and threat // Polish Botan. Journ. — 2001. — **46**, № 2. — P. 1—10.
32. *Kucowa I. Ligularia* Cass. Jкzyczka // Flora Polski. — T. XII. — Warszawa; Kraków: Państw. Wyd-wo Naukowe, 1971. — S. 318—320.
33. *Meusel H., Jäger E.J.* Vergleichende Chorologie der Zentraleuropäischen Flora. — B. III. — Jena; Stuttgart; New York: G. Fischer Verlag, 1992. — 650 s.
34. *Nakai T.* Notulae ad Plantas Asiae Orientalis (XXX) // Journ. Jap. Bot. — **XX**, № 3. — P. 135.
35. *Nyárády E.I.* Fam. 107. *Compositae* Adans. // Flora Republicii Populare Romîn. — T. IX. — Bucureşti: Edit. Acad. RPR, 1964. — S. 154—956.
36. *Olaczek R. Ligularia sibirica* (L.) Cass. — Języczka syberyjska // Polska Czerwona Księga Roślin / Red. R. Kaźmierczakowa, K. Zarzycki. — Kraków: PAN, 2001. — S. 379—380.
37. *Plant* population biology and vegetation processes / Ed. K. Falicska. — Kraków: Polish Acad. Sci., 1998. — 368 p.
38. *Procházka F., Pivničková M. Ligularia sibirica* (L.) Cass. // Červená kniha ohrozených a vzácnych druhov rastlín a živičíchov SR a ČR. Vyššie rastiny. — Bratislava: Príroda, 1999. — S. 219.
39. *Stuessy T.F.* Plant taxonomy: the systematic evaluation of comparative data. — New York: Columbia Univ. Press, 1990. — 513 p.
40. *Vörös Könyv.* A Magyarországon kipusztult es veszélyeztetett növény és állatfajok / Ed. Z. Rakonczay. — Budapest: Akadémiai Kiadó. — 360 p.
41. *Zapaiowicz H.* Roślinna szata gór Pokucko-Marmaroskich // Sprawozd. Kom. Fizyogr. — 1889. — **24**. — S. 1—390.

Recommended for publication by S.L. Mosyakin

Submitted 14.09.2004

Ю. Кобів

Інститут екології Карпат НАН України, м. Львів

LIGULARIA SIBIRICA (L.) CASS. (*ASTERACEAE*) У ЧОРНОГОРІ (УКРАЇНСЬКІ КАРПАТИ): ПОПУЛЯЦІЙНО-ОНТОГЕНЕТИЧНІ ПОКАЗНИКИ, МОРФОЛОГІЯ, ТАКСОНОМІЯ Й ОХОРОНА

Повідомлено про нову знахідку *Ligularia sibirica* в Чорногорі, першу для цього регіону і для Закарпаття. Подано її точне розташування на карті. Викладено онтогенетичні характеристики і популяційні параметри, а також природоохоронні міркування. Ця високожиттєва популяція налічує близько1 500 генеративних особин і, очевидно, є найбільшою в Україні. Отримані морфологічні дані свідчать, що чорногірські рослини не відповідають описові *Ligularia bucovinensis* — сумнівного «мікровиду», що начебто трапляється на території України.

Ю. Кобив

Институт экологии Карпат НАН Украины, г. Львов

LIGULARIA SIBIRICA (L.) CASS. (*ASTERACEAE*) В ЧЕРНОГОРЕ (УКРАИНСКИЕ КАРПАТЫ): ПОПУЛЯЦИОННО-ОНТОГЕНЕТИЧЕСКИЕ ПОКАЗАТЕЛИ, МОРФОЛОГИЯ, ТАКСОНОМИЯ И ОХРАНА

Сообщается о новой находке *Ligularia sibirica* в Черногоре, первой для этого региона и для Закарпатья. Приводится ее точное расположение на карте. Изложены онтогенетические характеристики и популяционные параметры, а также природоохранные соображения. Эта высокожизненная популяция насчитывает около 1 500 генеративных особей и, очевидно, является крупнейшей в Украине. Полученные морфологические данные свидетельствуют, что черногорские растения не отвечают описанию *Ligularia bucovinensis* — сомнительного «микровида», якобы встречающегося на территории Украины.