

## THE GENUS *CRATAEGUS* L. IN THE WESTERN PART OF THE BUFFER ZONE OF THE LOW TATRAS NATIONAL PARK (SLOVAKIA), IN ACCORDANCE WITH RECENT MORPHOLOGICAL AND SYSTEMATIC RECOGNITION

ANNA SOŁTYS-LELEK<sup>1</sup>, BEATA BARABASZ-KRASNY<sup>2</sup>, PETER TURIS<sup>3</sup>, INGRID TURISOVÁ<sup>4</sup>

**Abstract.** The work contains results of investigation on the genus *Crataegus* L., conducted in 2011-2012 on the area of the western part of the buffer zone of the Low Tatras National Park. Analysing various features, including the morphometric ones, occurrence of six native species, among them three species of hybrid origin, were confirmed in the investigated area. Comparative analysis of leaves morphology of the hybrid hawthorns and their original parental forms was carried out.

**Key words:** *Crataegus*, Rosaceae, morphology, chorology, Low Tatras National Park, Carpathians, Slovakia

<sup>1</sup> Ojców National Park, 32-047 Ojców 9, Poland; ana\_soltys@wp.pl

<sup>2</sup> Institute of Biology, Department of Botany, Pedagogical University, Podchorążych 2, 30-084 Kraków, Poland; beata\_barabasz@poczta.onet.pl

<sup>3</sup> Low Tatras National Park, Lazovná 10, 974 01 Banská Bystrica, Slovakia; e-mail: peter.turis@sopsr.sk

<sup>4</sup> Faculty of Natural Sciences, Department of the Environment Sciences, Matej Bel University, Tajovského 40, 974 01 Banská Bystrica, Slovakia; Ingrid.Turisoova@umb.sk

### Introduction

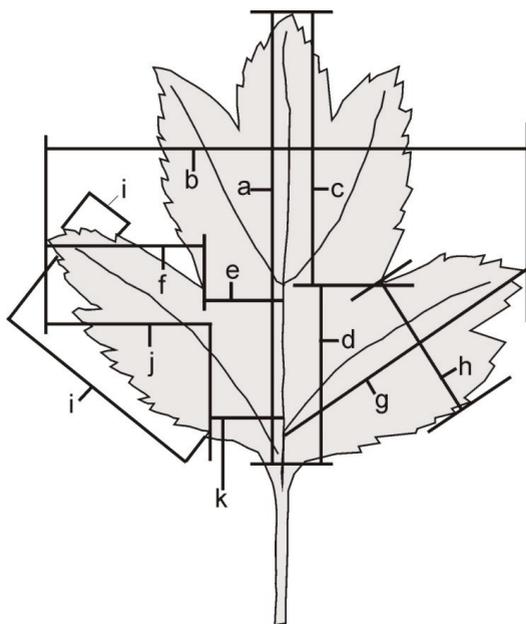
The genus *Crataegus* L. is the one which systematics is the most complicated, therefore it remains a subject of taxonomic research for many years. Hybridisation is the one of most important problems in identification of hawthorns. The genus consists of hybrids which may be morphologically so similar to one of the parents that determination of the species' borders is sometimes difficult.

Morphological features, such as the shape of leaves, morphology of fruits or the number of styles, have been used to identify hawthorns' species for a long time. Identification based on the changing features resulted in multiplication of the number of species' names, especially at the beginning of the 19<sup>th</sup> century. The latest taxonomic revision made by CHRISTENSEN (1992), covering the species growing in the area of the Old World, are based on investigations of the morphometric features of: subterminal leaves of flowering and short shoots as well as leaves from the central part of elongate shoots. Its include results of linear, angular, surface and other measurements (Fig. 1). The methodology

was supplemented by morphological data concerning the number of styles, the form of stipules and sepals (CHRISTENSEN 1992).

Occurrence of wild species of hawthorns in the whole area of the Low Tatras National Park (NAPANT) and its buffer zone has not been thoroughly investigated yet. According to the literature from the NAPANT area and its buffer zone, six species of hawthorn described by different synonyms, occur there. The data come mainly from the works on their general chronology in Slovakia, such as: HRABĚTOVÁ-UHROVÁ (1956, 1969, 1970), JURKO (1962), BARANEC (1986), JANIŠOVÁ (1995, 2008) and VALACHOVIČ (2011). Moreover, another work presenting detailed distribution of hawthorns in selected regions of the buffer zone of the NAPANT (SOŁTYS-LELEK *et al.* 2012) has been published lately.

Fragmentary data on occurrence of species from the genus *Crataegus*, as well as the change of the opinion on their taxonomic definition contributed to undertaking investigations which goal was to determine the list of hawthorns' species and their varieties growing in the area, in



**Fig. 1.** Quantitative characters scored on leaves from flowering shoots, short shoots and elongate shoot: **a** – length of leaf blade; **b** – width of leaf blade;  $c/c+d=c/a$  – location of basal sinus;  $f/e+e$  – depth of basal sinus = extension of basal lobe to midrib; **g** – length of basal lobe; **h** – width of basal lobe; **i+i** – number of teeth on basal lobe;  $j/j+k$  – ratio of serrate part of lobe to lobe length (according to CHRISTENSEN 1992).

accordance with the latest methodology of their identification and another systematic approach. The additional goal was to check applicability of morphometry to determine the critical species.

### Material and methods

The field investigations were conducted in the years of 2011-2012 in the western part of the buffer zone of the Low Tatras National Park (Fig. 2). Fruiting short shoots were used as the herbarium material. The morphometric features of hawthorns suggested by CHRISTENSEN (1992) were applied to identify the herbarium specimens. Special attention was given to measurements of subterminal leaves of flowering short shoots, the number of styles, the shape and amount of fruits and other features. The selected, comparative morphological features of the hawthorns are presented in the Tab. 1.

Systematic approach and the nomenclature

of the species were adopted after the works of CHRISTENSEN (1992, 1997) and JANJIĆ (2002). Herbarium material was deposited in the herbarium of the Ojców National Park (OPN).

Symbols used in article: CHA – Protected Site, leg. – legit, obs. – observation, OPN – Herbarium of the Ojców National Park, PP – Natural Monument, PR – Nature Reserve.

### Results

Analysing the complexes of morphological and morphometric features, occurrence of six native species of hawthorn, including three of the hybrid origin, were discovered on the investigated area. Its list and the sites of occurrence in the buffer zone of the NAPANT are presented below. Fig. 3 shows comparison of the morphology of the leaves of the hybrids and parental forms.

Gen. *Crataegus*

Ser. *Crataegus*

Subser. *Erianthae*

#### 1. *Crataegus laevigata* (Poiret) DC.

109 records (leg. & obs. Sołtys-Lelek): CHA Jakub, 20.09.2011 (OPN); CHA Kopec, 21.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); Pleše, 23.09.2011 (OPN); PR Mackov bok, 24.09.2011 (OPN); PR Sliáčske travertíny, 17.09.2012 (OPN); Liptovské Sliache, 17.09.2012 (OPN); Liptovská Štiavnica, 18.09.2012 (OPN); Biely Potok, 19.09.2012 (OPN); Liptovská Lúžna, 21.09.2012; PP Meandre Lúžňanky, 21.09.2012.

Subser. *Crataegus*

#### 2. *C. rhipidophylla* Gand.

The species was found in the study area in two varieties, distinctly different in setting sepals.

##### a) var. *rhipidophylla*

Fruits crowned by spreading or reflexed sepals.

25 records (leg. & obs. Sołtys-Lelek): CHA Jakub, 20.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); Pleše, 23.09.2011

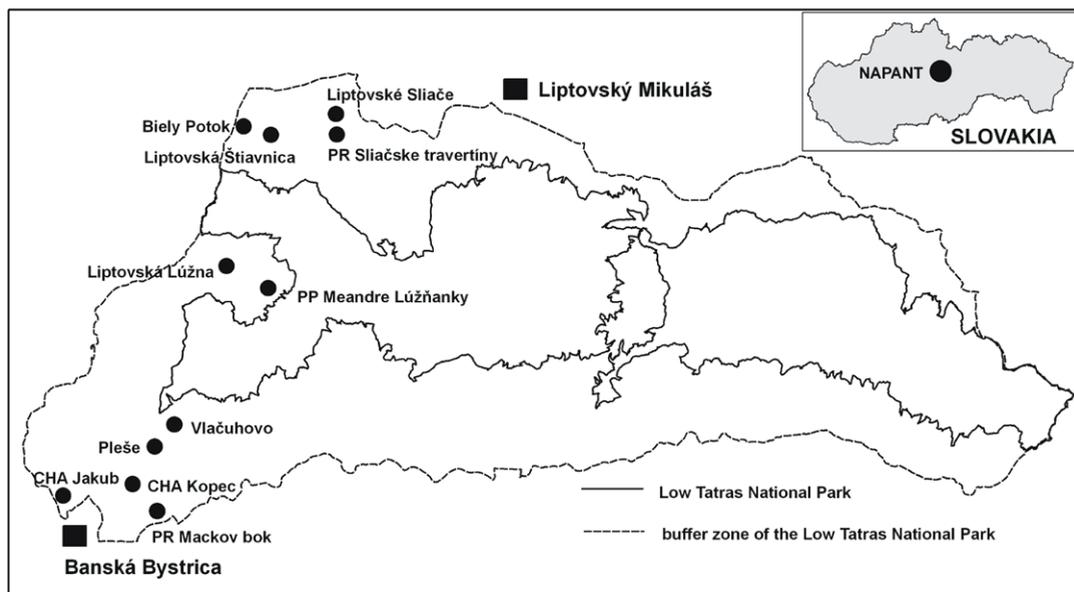


Fig. 2. Localization of the study area.

(OPN); PR Mackov bok, 24.09.2011 (OPN); Liptovská Štiavnica, 18.09.2012 (OPN); Biely Potok, 19.09.2012 (OPN); Liptovská Lúžna, 21.09.2012 (OPN).

**b) var. *ronnigeri* (K. Malý) Janjič**

Most of or all fruits crowned by erect-suberect sepals.

7 records (leg. & obs. Sołtys-Lelek): Pleše, 23.09.2011 (OPN); PR Mackov bok, 24.09.2011 (OPN); Liptovské Sliache, 17.09.2012 (OPN); Biely Potok, 19.09.2012 (OPN); Liptovská Lúžna, 21.09.2012.

**3. *C. monogyna* Jacq. var. *monogyna***

Species occurs in one variety about leaf blades villous in vein axils or along major veins beneath.

37 records (leg. & obs. Sołtys-Lelek): CHA Jakub, 20.09.2011 (OPN); CHA Kopec, 21.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); Pleše, 23.09.2011; PR Sliache travertíny, 17.09.2012; Liptovské Sliache, 17.09.2012; Liptovská Štiavnica, 18.09.2012 (OPN); Biely Potok, 19.09.2012; Liptovská Lúžna, 21.09.2012.

Nothospecies:

**4. *C. ×macrocarpa* Hegetschw.**

The species was found in the study area in two varieties, distinctly different in setting sepals.

**a) nothovar. *macrocarpa***

Fruits crowned by spreading or reflexed sepals.

35 records (leg. & obs. Sołtys-Lelek): CHA Jakub, 20.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); Pleše, 23.09.2011 (OPN); PR Sliache travertíny, 17.09.2012 (OPN); Liptovské Sliache, 17.09.2012 (OPN); Liptovská Štiavnica, 18.09.2012 (OPN); Biely Potok, 19.09.2012 (OPN); Liptovská Lúžna, 21.09.2012.

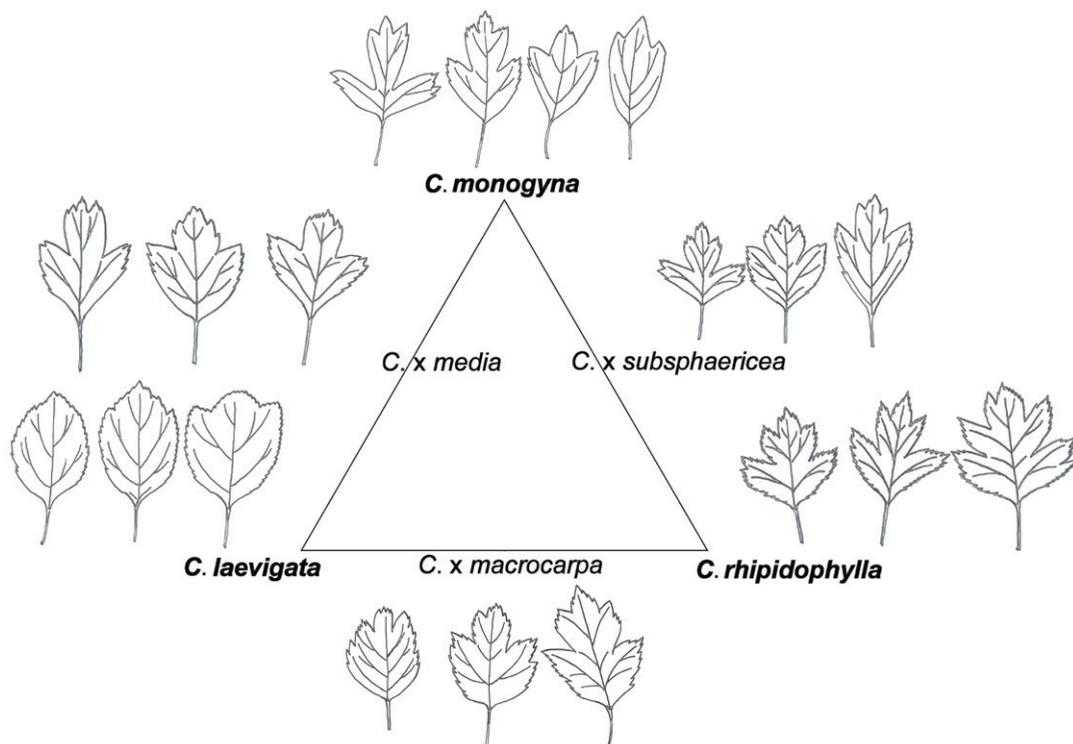
**b) nothovar. *calycina* (Peterm.) Kerguélen**

Most or all fruits crowned by erect-suberect sepals.

19 records (leg. & obs. Sołtys-Lelek): CHA Jakub, 20.09.2011 (OPN); CHA Kopec, 21.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); Pleše, 23.09.2011 (OPN); Liptovské Sliache, 17.09.2012 (OPN); Liptovská Štiavnica,

**Table 1.** Comparison of selected morphological features used to distinguishing *Crataegus* species (accordingly to CHRISTENSEN 1992).

Features	<i>C. laevigata</i>	<i>C. ×macrocarpa</i>	<i>C. rhipidophylla</i>	<i>C. ×subsphaericea</i>	<i>C. monogyna</i>	<i>C. ×media</i>
Subterminal leaf blades of flowering shoots						
long (cm)	1.3-5.7	1.9-5.1	2.0-6.5	1.7-7.1	1.1-5.7	0.9-4.5
wide (cm)	0.9-5.0	1.6-4.9	1.2-6.9	1.5-5.6	0.8-6.0	0.8-4.3
lobes (pairs)	(0) 1-2	1-3	2-4	1-4	1-3	1-3
extending the width of lamina to midrib	0.4-0.7 times	0.4-0.8 times	0.6-0.8 times	0.6-0.9 times	0.5-1.0 times	0.5-0.9 times
no. of teeth on basal lobe	6-23	7-30	6-25	2-22	0-9	4-14
type of teeth	more or less fine	more or less fine	more or less fine	more or less obtuse	more or less coarse	more or less coarse
no. of teeth on stipules	11-41	8-49	8-29	3-22	entire or 1-8	(0-)5-24
Subterminal leaf blades of short shoots						
long (cm)	2.0-6.0	2.9-5.6	1.8-5.8	2.4-5.8	1.1-5.7	1.4-5.2
wide (cm)	1.5-3.2	2.1-4.7	1.8-5.0	2.3-4.6	0.8-5.4	1.0-4.4
lobes (pairs)	1-3	1-3	2-3	2-4	1-4	1-3
extending the width of lamina to midrib	0.3-0.7 times	0.5-0.8	0.6-0.9 times	0.6-1.0 times	0.5-0.9 times	0.4-0.9 times
no. of teeth on basal lobe	10-21	9-30	7-28	7-19	1-14	5-19
Hypanthium						
styles	(1-)2-3(-5)	1-2(-3)	1(-2)	1 (-2)	1(-2)	1-2(-3)
Sepals						
long (mm)	0.9-2.8	1.8-4.9	1.8-5.5	1.9-5.1	1.2-4.4	1.9-3.3
wide (mm)	1.4-2.6	1.6-3.7	1.2-2.6	1.8-3.0	1.2-2.6	1.8-3.5
type of sepals	broadly triangular	narrowly triangular	more or less narrowly triangular	more or less narrowly triangular	more or less narrowly triangular	broadly to more or less narrowly triangular
apex of sepals	acute	more or less acuminate or acute	more or less acuminate	acute or more or less acuminate	acute or obtuse	acute or obtuse



**Fig. 3.** Comparison of subterminal leaf blades of flowering shoots used to distinguishing *Crataegus* species and their nothospecies.

18.09.2012 (OPN); Biely Potok, 19.09.2012 (OPN).

#### **5. *C. x subsphaericea* Gand.**

The species was found in the study area in two varieties, distinctly different in setting sepals.

##### **a) nothovar. *subsphaericea***

Fruits crowned by reflexed or spreading sepals.

6 records (leg. & obs. Soltys-Lelek): CHA Jakub, 20.09.2011 (OPN); Vlačuhovo, 22.09.2011 (OPN); PR Sliachske travertíny, 17.09.2012 (OPN).

##### **b) nothovar. *domicensis* (Hrabětová-Uhrová) Christensen**

Fruits crowned by erect-suberect sepals.

1 record (leg. Soltys-Lelek): Liptovská Štiavnica, 18.09.2012 (OPN).

#### **6. *C. x media* Bechst. nothovar. *media***

Species occurs in one variety about inflorescence glabrous or subglabrous and subterminal leaf blades villous in vein axils beneath.

4 records (leg. & obs. Soltys-Lelek): CHA Kopec, 21.09.2011 (OPN); Pleše, 23.09.2011 (OPN); Liptovská Štiavnica, 18.09.2012 (OPN).

#### **Discussion and conclusions**

The alternative method of hawthorns' identification proposed by CHRISTENSEN (1992) based on morphometric features and complexes of other morphological features is very advantageous, especially, when determining forms of the hybrid origin. However, it is more applicable in laboratory conditions than in the field. Hybrid species, unlike the parental specimens, are often marked by transitional features. Nevertheless, it should be also noted that hybrid forms have quite

changeable features, more or less similar to one of the parents. When it occurs, such species are relatively hard to identify. The analysis of variability of subterminal leaves of flowering short shoot (Fig. 3) is an example illustrating the phenomenon. For instance, *C. ×media*, a hybrid of *C. monogyna* and *C. laevigata*, has leaves which bear distinctive transitional features between the leaves of the parental forms, but they also show significant variability. It restrains their simple identification. Therefore, complex analysis of many morphological features, including morphometry of the leaves is necessary (Tab. 1). Changeable similarity of the hybrids to their parental species within the genus *Crataegus* resulted in their description under different names, as mentioned in the introduction. Consequences of the situation can be observed in the available literature on the critical genus (CHRISTENSEN 1992; HRABĚTOVÁ-UHROVÁ 1956, 1969, 1970). Hence, further search for “good” morphological and anatomical features enabling more precise and easier determination of the borders between species is required.

Applying the newer approach to identify hawthorns, three species and three nothospecies were found in the investigated area. It was a complete set of hawthorns' species common in the whole Slovakia. *C. laevigata* (109 records) and *C. ×macrocarpa* – a hybrid between *C. laevigata* and *C. rhipidophylla* (50 records) occur in the biggest number in the investigated area. *C. ×macrocarpa* nothovar. *calycina* and *C. ×subsphaericea* nothovar. *domicensis* are the most interesting varieties found in the area. Those are the varieties expanding mainly from the southern parts of Scandinavia to the Central Europe (CHRISTENSEN 1992). According to the current knowledge on the subject, their occurrence in Slovakia may be described as rather rare, while *C. ×subsphaericea* nothovar. *domicensis* belongs to rare species within the whole range.

### Acknowledgement

The study was financially supported by the Science Grant Agency of the Ministry of

Education of the Slovak Republic and Slovak Academy of Sciences (VEGA 2/0099/13).

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