ACTA BIOLOGICA CRACOVIENSIA Series Botanica 55/2: 153–157, 2013
DOI: 10.2478/abcsb-2013-0030

CHROMOSOME NUMBERS IN 10 *TARAXACUM* SPECIES FROM POLAND

ADAM KULA[1], ALEKSANDRA GRABOWSKA-JOACHIMIAK[1*], MAGDALENA KASJANIUK[2], JUSTYNA LEGUTKO[1], PAWEŁ MARCINIUK[3], AND KRYSTYNA MUSIAŁ[2]

[1]*Department of Plant Breeding and Seed Science, University of Agriculture, Łobzowska 24, 31-140 Cracow, Poland*
[2]*Department of Plant Cytology and Embryology, Institute of Botany, Jagiellonian University, Gronostajowa 9, 30-387 Cracow, Poland*
[3]*Department of Botany, Siedlce University of Natural Sciences and Humanities, Prusa 12, 08-110 Siedlce, Poland*

Received October 28, 2013; revision accepted December 1, 2013

Somatic chromosome numbers are given for the following *Taraxacum* species: *T. pieninicum*, 2n=16; *T. dentatum*, 2n=24; *T. fascinans*, 2n=24; *T. mendax*, 2n=40; *T. subalpinum*, 2n=24; *T. telmatophilum*, 2n=24; *T. cyanolepis*, 2n=24; *T. fulgidum*, 2n=24; *T. gentile*, 2n=24; and *T. undulatum*, 2n=24. Chromosome numbers from Poland are published for the first time for *T. dentatum*, *T. fascinans*, *T. mendax*, *T. subalpinum*, *T. telmatophilum*, *T. cyanolepis*, *T. fulgidum*, *T. gentile* and *T. undulatum*.

Key words: Asteraceae, *Taraxacum*, section *Palustria*, section *Erythrocarpa*, section *Ruderalia*, chromosome number, Poland.

INTRODUCTION

The species-rich genus *Taraxacum* is interesting from many aspects. Like the genera *Rubus* and *Hieracium*, it groups hundreds of apomictic microspecies and by many researchers is treated as a model taxon for studies of this mode of reproduction (Richards, 1970; van Dijk, 2003; Martonfiova et al., 2007). Many dandelion species are medicinal plants and honey plants, and some of them are burdensome weeds. The majority, especially those of sect. *Palustria*, are rare, poorly known, and in danger of extinction due to the disappearance of the habitats where they grow (Marciniuk, 2012).

The genus *Taraxacum* includes diploid species (2n=2x=16) which reproduce sexually, the most widespread triploid apomictic species (2n=3x=24), and less numerous higher polyploids which usually are agamous (Záveská Drábková et al., 2009). Knowledge of chromosome numbers within the genus is far from sufficient. According to Gacek et al. (2011), 91% of the *Taraxacum* species from Poland remain to be studied. The most substantial contribution to karyological research on dandelions from Poland, especially those of sect. *Palustria*, was made by Prof. Janina Małecka (1972, 1973, 1978). In the context of changes in the natural environment and our poor knowledge of the mechanisms of karyological variability in this group of plants, there is a need to supply missing data and to confirm some previous reports.

We studied the karyology of 10 *Taraxacum* species from Poland belonging to the *Palustria*, *Erythrocarpa* and *Ruderalia* sections (Tab. 1). The plant material was examined and identified by P. Marciniuk, and the identity of problematic specimens was verified by Jan Štepánek (*T. dentatum*, *T. mendax*, *T. telmatophilum*), Ingo Uhlemann (*T. fascinans*, *T. subalpinum*), Piet Oosterveld (*T. fulgidum*, *T. undulatum*) and Bohumil Trávníček (*T. gentile*). The herbarium material is deposited in the Herbarium of the Jagiellonian University in Cracow (KRA).

Roots of juvenile seedlings or grown specimens were incubated for 4 h in saturated solution of 8-hydroxychinoline and then fixed in 3:1 acetic alcohol. For chromosome counts the root tips were stained in acetic orcein or hydrolyzed with 1N HCl at 60°C and stained with toluidine blue.

*e-mail: rrjoachi@cyf-kr.edu.pl

PL ISSN 0001-5296

CHROMOSOME NUMBERS

Taraxacum pieninicum Pawł.
(sect. *Erythrocarpa*), 2n=16 (Fig. 1a)

Endemic to the Pieniny Mts., critically endangered (Zarzycki et al., 2001). Its *locus classicus* on the slopes of Okrąglica has disappeared and for many years it was considered extinct (Mirek et al., 2002). *T. pieninicum* reproduces sexually but it is also capable of vegetative reproduction. It grows well in cultivation, a fortunate feature should it become extinct in nature. Also, recently an efficient system of in vitro micropropagation has been developed for it (Trejgell et al., 2013).

Previous published reports of chromosome number 2n=16 in this taxon come only from the mid 20th century (Małecka, 1958, 1961). According to Wróbel and Zarzycki (2008) it was also recorded in 2002 by Prof. Romana Czapik. Although we confirmed the diploid number in seedlings and plantlets grown from seeds collected in the Pieniny Mts., tetraploid metaphase plates were observed in the studied material equally often (Fig. 1d), indicating polysomaty of root-tip meristems or chromosomal instability of the studied specimens. This requires further research.

Taraxacum dentatum Kirschner & Štepánek
(sect. *Palustria*), 2n=24 (Fig. 1b).

A Central European species with localities spread from Germany to Hungary through Poland, the Czech Republic and Slovakia. It is quite variable morphologically and produces pollen. In the long term the species is threatened with extinction because the localities are dispersed and its populations are never abundant. Another adverse factor is competition from other plants which displace it into abnormal habitats such as wheel ruts or trampled places (Marciniuk, 2012). This is the first chromosome number report from Poland for this taxon. The triploid chromosome number (2n=24) we established agrees with the number reported for plants from Bohemia by Kirschner and Štepánek (1994).

Taraxacum undulatum Lindb. F. & Marklund
(sect. *Ruderalia*), 2n=24 (Fig. 1c).

Its occurrence was recorded in Fennoscandia, Belgium, Holland, France and Karelia (Russia). It probably was brought to Estonia and Alaska. In Poland it has scattered localities mainly in the southern and eastern parts of the country (Tacik, 1980; Trávníček et al., 2007). It grows mainly in wet meadows, on lawns and on slag heaps. This is the first chromosome number report from Poland for this taxon. According to the Index to Plant Chromosome Numbers (IPCN) the chromosome number of this species has been published only from Finland.

Taraxacum mendax Kirschner & Štepánek
(sect. *Palustria*), 2n=40 (Fig. 1e).

The center of distribution of this species is located in the Western Carpathians. It grows in dispersed localities in Austria, the Czech Republic, Slovenia and Hungary. In Poland *T. mendax* occurs in the Carpathians, Ponidzie and Silesia. Its low variability makes it difficult to mistake for another dandelion species in the flora of Poland. Due to its narrow habitat requirements – it grows in wet meadows (*Molinion*) and fertile fens (*Caricion davallianae*) – it is in danger of extinction. It produces pollen (Marciniuk et al., 2010). The pentaploid chromosome number of the species was reported by Kirschner and Štepánek (1985) for plants growing in two localities in Slovakia. This is the first chromosome number report from Poland for this taxon.

Taraxacum telmatophilum Kirschner & Štepánek
(sect. *Palustria*), 2n=24 (Fig. 1f).

Low growth and morphological variability of leaves are distinctive characteristics of this species. This Pannonian species is known from a few localities at its northern range limit in eastern Poland (peat bogs near Chełm and Siedlce). Due to the specific character and dispersion of its habitats, in Poland it is a threatened species (Marciniuk, 2012). This is the first chromosome number report from Poland for this taxon. It agrees with the one given by Kirschner and Štepánek (1986) for specimens from Slovakia (cit. from Marhold et al., 2007).

Taraxacum cyanolepis Dahlst.
(sect. *Ruderalia*), 2n=24 (Fig. 1g).

It occurs in Fennoscandia, Scotland, Belgium, Holland, the Czech Republic and Slovakia in meadows and at roadsides (Sell and Murrell, 2006). In Poland it was found in Mazovia and Podlasie and was described as a species new for Poland (Głowacki and Øllgaard, 1999). *T. cyanolepis* is common in the vicinity of Siedlce (Głowacki et al., 2001). This is the first chromosome number report from Poland for this taxon. Previously its chromosome number was given only for plants from Germany (Lippert, 2006).

Taraxacum fulgidum G.E. Haglund (sect. *Ruderalia*),
2n=24 (Fig. 1h).

The species is characteristic of Northern Europe: Fennoscandia, the British Isles, Iceland, Ireland, Belgium and Holland, where it grows in wet meadows (Sell and Murrell, 2006). Like *T. cyanolepis*, in

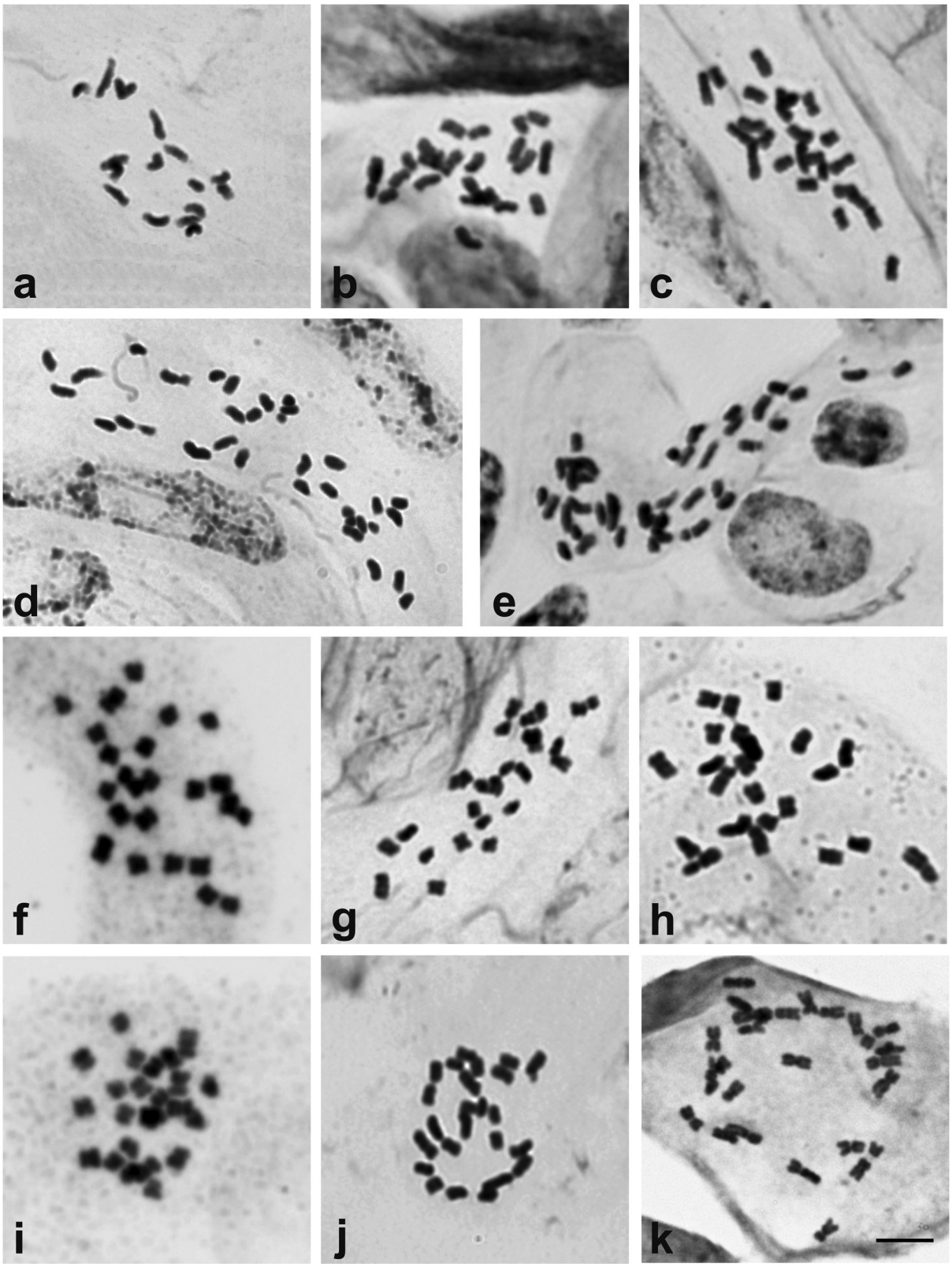

Fig. 1. Mitotic chromosomes of (**a**) *Taraxacum pieninicum* 2n=16, (**b**) *T. dentatum* 2n=24, (**c**) *T. undulatum* 2n=24, (**d**) *T. pieninicum* 2=32, (**e**) *T. mendax* 2n=40, (**f**) *T. telmatophilum* 2n=24, (**g**) *T. cyanolepis* 2n=24, (**h**) *T. fulgidum* 2n=24, (**i**) *T. fascinans* 2n=24, (**j**) *T. gentile* 2n=24, (**k**) *T. subalpinum* 2n=24. Bar in **k**=5 μm and corresponds to all figures.

TABLE 1. Taraxacum species studied, with locality and geographic coordinates

Species/Section	Locality	Geographical coordinates
T. pieninicum (Erythrocarpa)	Pieniny	49°24' N 20°24' E
T. dentatum (Palustria)	Wyszatyce near Przemyśl	49°49' N 22°52' E
T. fascinans (Palustria)	Świecie on the Vistula River	53°24' N 18°28' E
T. mendax (Palustria)	Matulnik, Dynów Foothills	49°52' N 22°06' E
T. subalpinum (Palustria)	Pyzdry	52°09' N 17°41' E
T. telmatophilum (Palustria)	Gotówka	51°10' N 23°32' E
T. cyanolepis (Ruderalia)	Czubaki near Siedlce	52°15' N 22°24' E
T. fulgidum (Ruderalia)	Czuchów, Toczna River Valley	52°16' N 22°46' E
T. gentile (Ruderalia)	Chojniki, at the Omulew River	53°07' N 21°23' E
T. undulatum (Ruderalia)	Czuchów, Toczna River Valley	52°16' N 22°46' E

Poland it was found and identified by Głowacki and Øllgaard (1999) in Mazovia and Podlasie. The chromosome number 2n=24 agrees with the number already established by den Nijs and Sterk (1982) for plants from outside Poland. This is the first chromosome number report from Poland for this taxon.

Taraxacum fascinans Kirschner, Mikoláš & Štepánek (sect. *Palustria*), 2n=24 (Fig. 1i).

It is a Pannonian Central European species, occurring in Poland, the Czech Republic, Slovakia, Germany and Hungary. In Poland it is known from two localities in the Lower Vistula Valley. It grows in wet meadows (*Molinion*, *Calthion, Alopecurion* and *Cnidion dubii*). The species shows low morphological variation and is considered to be an intermediate taxon between sections *Ruderalia* and *Palustria*. It produces pollen (Marciniuk, 2012). This is the first chromosome number report from Poland for this taxon. It agrees with the triploid number established for this species by Kirschner and Štepánek (1997, cit. from Index to Plant Chromosome Numbers (IPCN)).

Taraxacum gentile Haglund & Railonsala (sect. *Ruderalia*), 2n=24 (Fig. 1j).

This species varies little morphologically and thus is easy to distinguish. It grows mainly in Germany, Switzerland, Austria and the Czech Republic, and also occurs in other European countries, including Poland, where 36 confirmed natural localities in the eastern part of the country were described. Like representatives of sect. *Palustria* it prefers wet places; less often it grows in human-altered localities. It is considered rare throughout its distribution area (Marciniuk and Marciniuk, 2012). This is the first chromosome number report from Poland for this taxon.

Taraxacum subalpinum Hudziok (sect. *Palustria*), 2n=24 (Fig. 1k).

The species differs from *T. fascinans* mainly by the shape and color pattern of its outer phyllaries and leaf shape, and by the lack of pollen. It shows a number of features intermediate between the *Palustria* and *Ruderalia* sections. The centre of its distribution is in Central Europe. It is quite frequent in western Poland. The Vistula River marks the eastern limit of its range. It prefers wet fertile meadows and rarely grows in human-altered localities. It is not threatened with extinction (Marciniuk, 2012). This is the first chromosome number report from Poland for this taxon. The same chromosome number was given for it by Kirschner and Štepánek (1985) for plants from the Czech Republic.

These results add to the chromosome numbers reported for Polish representatives of the genus *Taraxacum*, particularly those belonging to the karyologically diverse *Palustria* section. So far, chromosome numbers are known for 14 of the 23 *Palustria* species whose localities have been confirmed recently in Poland (Marciniuk, 2012; Marciniuk et al., 2012). Eight of them are triploids, four are tetraploids, and two (*T. skalinskianum*, *T. zajacii*) are pentaploids. The data on *T. dentatum* (2n=24), *T. fascinans* (2n=24), *T. mendax* (2n=40), *T. subalpinum* (2n=24) and *T. telmatophilum* (2n=24) contribute to the list. *T. balticum*, *T. hollandicum*, *T. madidum* and *T. subpolonicum* remain to be investigated.

ACKNOWLEDGEMENTS

This work was supported by the Polish Ministry of Science and Higher Education (grant no. N N303 807940).

REFERENCES

Den Nijs JCM, and Sterk AA. 1982. IOPB chromosome number reports LXXVI. *Taxon* 31: 580–582.

Gacek P, Góralski G, and Joachimiak AJ. 2011. Chromosome numbers and polyploidy in Polish Angiosperms. *Acta Biologica Cracoviensia Series Botanica* 53/2: 37–49.

Głowacki Z, and Øllgaard H. 1999. Taxa of *Taraxacum* (Asteraceae) in the Mazowsze and Podlasie regions (Poland). *Fragmenta Floristica et Geobotanica* 44: 49–57.

Głowacki Z, Krechowski J, and Falkowski M. 2001. Gatunki rodzaju *Taraxacum* miasta Siedlce. *Roczniki Akademii Rolniczej w Poznaniu* 334, Bot. 4: 65–69.

Index to Plant Chromosome Numbers (IPCN) – http://www.tropicos.org/Project/IPCN

Kirschner J, and Štepánek J. 1985. Selected and annotated chromosome counts in *Taraxacum* sect. *Palustria* Dahlst. (Studies in *Taraxacum* 3). *Folia Geobotanica et Phytotaxonomica* 20: 407–417.

Kirschner J, and Štepánek J. 1986. Towards to monograph of *Taraxacum* sect. *Palustria* (Studies in *Taraxacum* 5). *Preslia* 58: 97–116.

Kirschner J, and Štepánek J. 1994. *Taraxacum* sect. *Palustria* (Compositae) in Bohemia. A contribution to the RAMSAR sites. *Thaiszia – Journal of Botany* 4: 125–170.

Kirschner J, and Štepánek J. 1997. Notes on the series of Taraxaca Exsiccata, Fasc. V–VII (Studies in *Taraxacum* 16). *Preslia* 69: 35–58.

Lippert W. 2006. Chromsomenzahlen von Pflanzen aus Bayern und anderen Gebieten. *Berichte der Bayerischen Botanischen Gesellschaft* 76: 85–110.

Małecka J. 1958. Chromosome numbers of some *Taraxacum*-species in Poland. *Acta Biologica Cracoviensia Series Botanica* 1: 55–56.

Małecka J. 1961. Studies in the mode of reproduction of the diploid endemic species *Taraxacum pieninicum* Pawł. *Acta Biologica Cracoviensia Series Botanica* 4: 24–42.

Małecka J. 1972. Further cyto-taxonomic studies in the genus *Taraxacum* section *Palustria* Dahlstedt. *Acta Biologica Cracoviensia Series Botanica* 15: 113–126.

Małecka J. 1973. Problems of the mode of reproduction in microspecies of *Taraxacum* section *Palustria* Dahlstedt. *Acta Biologica Cracoviensia Series Botanica* 16: 37–84.

Małecka J. 1978. Further cyto-taxonomic studies in the genus *Taraxacum* section *Palustria* Dahlstedt. Part III. *Acta Biologica Cracoviensia Series Botanica* 21: 109–115.

Marchold K, Mártonfi P, Mereda P, and Mráz P [eds.]. 2007. *Chromosome Number Survey of the Ferns and Flowering Plants of Slovakia*. Veda, Bratislava.

Marciniuk J. 2012. *Taraxacum* sect. *Palustria* in Poland. University of Natural Sciences and Humanities, Siedlce.

Marciniuk P, and Marciniuk J. 2012. *Taraxacum gentile* (Asteraceae) – characteristics of the species and its distribution in Poland. *Fragmenta Floristica et Geobotanica Polonica* 19: 39–44.

Marciniuk J, Grabowska-Joachimiak A, and Marciniuk P. 2010. Differentiation of the pollen size in five representatives of *Taraxacum* sect. *Palustria*. *Biologia* 65: 954–957.

Marciniuk P, Musiał K, Joachimiak AJ, Marciniuk J, Oklejewicz K, and Wolanin M. 2012. *Taraxacum zajacii* (Asteraceae) a new species from Poland. *Annales Botanici Fennici* 49: 387–390.

Martonfiova L, Majesky L, and Martonfi P. 2007. Polyploid progeny from crosses between diploid sexuals and tetraploid apomictic pollen donors in *Taraxacum* sect. *Ruderalia*. *Acta Biologica Cracoviensia Series Botanica* 49: 47–54.

Mirek Z, Piękoś-Mirkowa H, Zając A, and Zając M. 2002. *Flowering Plants of Poland. A Checklist*. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

Richards AJ. 1970. Eutriploid facultative agamospermy in *Taraxacum*. *New Phytologist* 69: 761–774.

Sell P, and Murrell G. 2006. *Flora of Great Britain and Ireland*. Vol. 4. Campanulaceae – Asteraceae, 157–178. Cambridge University Press.

Tacik T. 1980. *Taraxacum* Wiggers, Mniszek (Dmuchawiec). In: Jasiewicz A. *Flora Polska* 14: 7–199.

Trávníček B, Marciniuk J, and Žíla V. 2007. New localities of *Taraxacum* species from S Poland (with nine new species for Polish flora). *Acta Societatis Botanicorum Poloniae* 76: 209–224.

Trejgell A, Chernetskyy M, Podlasiak J, and Tretyn A. 2013. An efficient system for regenerating *Taraxacum pieninicum* Pawł. from seedling explants. *Acta Biologica Cracoviensia Series Botanica* 55/1: 73–79.

van Dijk PJ. 2003. Ecological and evolutionary opportunities of apomixis: insights from *Taraxacum* and *Chondrilla*. *Philosophical Transactions of Royal Society of London* B 358: 1113–1121.

Wróbel I, and Zarzycki K. 2008. *Taraxacum pieninicum* Pawł. Mniszek pieniński. In: Mirek Z, Piękoś-Mirkowa H [eds.], *Czerwona Księga Karpat Polskich*, Rośliny Naczyniowe, 406–408. Instytut Botaniki im. W. Szafera PAN, Instytut Ochrony Przyrody PAN, Kraków.

Zarzycki K, Wróbel I, and Wróbel S. 2001. *Taraxacum pieninicum* Pawł. Mniszek pieniński. In: Kaźmierczakowa R, Zarzycki K [eds.], *Polska Czerwona Księga Roślin, Paprotniki i Rośliny Kwiatowe*, 392–393. Instytut Botaniki im. W. Szafera i Instytut Ochrony Przyrody PAN, Kraków.

Záveská Drábková L, Kirschner J, Štepánek J, Závesky L, and Vlček È. 2009. Analysis of nrDNA polymorphism in closely related diploid sexual, tetraploid sexual and polyploid agamospermous species. *Plant Systematics and Evolution* 278: 67–85.