

Chorology and taxonomic issues of *Taraxacum danubium* and *Taraxacum tortilobum* (section *Erythrosperma*), new species to the Polish flora

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Summary: In the past 20 years, the interest in *Taraxacum* has considerably increased among Polish botanists, however, with the exception of marsh dandelions (*Taraxacum* section *Palustria*), the taxonomy and chorology of this group are still poorly examined. In 2012, comprehensive taxonomic-chorological studies on *Taraxacum* sect. *Erythrosperma* were launched in Poland. *T. danubium* and *T. tortilobum*, species previously unknown in Poland, were identified during this research. We found that these rare dandelion species occur in Poland regionally. Karyological analysis showed the triploid chromosome number ($2n = 3x = 24$) in both taxa. Current research results also suggest that the previously mentioned diploid *T. erythrospermum* does not occur in Poland.

Keywords: *Taraxacum* sect. *Erythrosperma*, taxonomy, distribution, chromosome number, Poland

Taraxacum Wigg. shows a very high taxonomic complexity due to the prevalence of polyploidy, the coexistence of apomicts and sexuals, hybridization processes, as well as a low level of morphological differentiation (ZÁVESKÁ DRÁBKOVÁ et al. 2009). At present, over 2,800 *Taraxacum* species are known, grouped into about 60 sections and about 380 species, classified into 13 sections, are recorded in Poland (MARCINIUK et al. 2010; KIRSCHNER et al. 2015). Most of them belong to the section *Ruderalia* (ca 300), the sections *Erythrosperma*, *Hamata* and *Palustria* are relatively numerous, while the sections *Alpestris*, *Alpina*, *Borea*, *Celtica*, *Erythrocarpa*, *Fontana*, *Macrodonia*, *Naevisa* and *Piesis* are represented in the Polish flora by one or several species (MARCINIUK et al. 2010; MARCINIUK 2012; MARCINIUK et al. 2012; MARCINIUK et al. 2016).

Although an interest in the *Taraxacum* genus has increased significantly among the Polish botanists in the past 20 years, knowledge concerning the Polish dandelion flora is still fragmentary and only species assigned to section *Palustria* can be regarded as well explored (MARCINIUK 2012). Data on chromosome numbers is also incomplete, with only about 10% of the Polish dandelion species examined so far (GACEK et al. 2011).

The main Polish taraxacology work elaborated by TACIK (1980) includes eighteen dandelion species of section *Erythrosperma* that occur or are potentially present in Poland, albeit this data was based on limited herbarium material (collected mainly from Kraków's surroundings) and DOLL's approximate species distribution maps (DOLL 1973). In later years, several localities of few species, mentioned by TACIK (1980), *T. disseminatum* G.E. Haglund, *T. parnassicum* Dahlst. (= *T. silesiacum* Dahlst. ex G.E. Haglund), *T. proximum* (Dahlst.) Raunk., *T. brachyglossum* (Dahlst.) Raunk., *T. dissimile* Dahlst. and *T. tenuilobum* (Dahlst.) Dahlst., were reported mainly from the northern part of Poland (ØLLGAARD et al. 2000; ØLLGAARD et al. 2002a; ØLLGAARD et al. 2002b; ØLLGAARD et al. 2002c; GŁOWACKI & CZARNA 2003). There is also some data on the occurrence of two Central European species in Poland, *T. bellicum* Sonck (= *T. prunicolor*

Schmid, Vašut & Oosterv.) and *T. cristatum* Kirschner, Štěpánek & Vašut (VAŠUT et al. 2005; MARCINIUK et al. 2009). Due to the poor and outdated knowledge on *Taraxacum* sect. *Erythrosperma* species taxonomy and chorology in Poland, a comprehensive study of the species diversity and distribution, phenotypic variability, karyology, habitat preferences and threats to individual taxa was launched in 2012.

This paper presents *T. danubium* Richards and *T. tortilobum* Florstr., species previously unknown in Poland. This report is based on field investigations and revisions of herbarium material from the Polish populations of these species and contains distribution map, chromosome report, morphological description and additional taxonomic notes.

Materials and methods

Field studies were carried out in Poland in 2012–2017, from mid-April to mid-May in each of the growing seasons. Geographical coordinates of species populations were marked using a GPS equipment. A species distribution map was prepared using cartogram (ATPOL) method (ZAJĄC 1978). Specimens of the analysed taxa were identified by the first author and their taxonomic identification was additionally confirmed by Dr Radim Vašut (Palacký University Olomouc, Czech Republic). Live plants were collected from natural populations for use as herbarium material and for cultivation. Observations and measurements used in the morphological descriptions were performed both on living plants and herbarium materials. Herbarium specimens are deposited in the herbarium of the Department of Botany, Rzeszów University. We also used materials available in the herbaria of the W. Szafer Institute of Botany of the Polish Academy of Sciences [KRAM] and the Institute of Botany of the Jagiellonian University [KRA].

For cytological examinations, seeds of the species studied were collected from natural populations. Then, they were germinated on moistened filter paper in Petri dishes. The karyological analysis was carried out on the root tip meristems of two- or three day-old seedlings that were pre-treated with saturated aqueous solution of 8-hydroxyquinoline for 4 h at room temperature. Then, after rinsed with distilled water, they were fixed in a freshly prepared mixture of absolute ethanol and glacial acetic acid (3:1, v/v) for 24 h. After fixation, the material was stained in 2% acetic orcein for 4–5 days at room temperature. Stained seedlings were transferred to 45% acetic acid and heated to boiling. For slide preparation, root meristems were cut off under a stereoscopic microscope and squashed between a glass slide and coverslip in a drop 45% acetic acid. The coverslip was removed by freezing it in liquid nitrogen and the slide was air dried and mounted in Entellan. The metaphase chromosomes were counted and photographed using a Nikon Eclipse E400 microscope equipped with CCD sensor.

Results and discussion

Taraxacum danubium Richards, Acta Fac. rer. Nat. Univ. Comenianae, 18: 108 (1970); Fig. 1.

[*Taraxacum austriacum* var. *danubium* (Richards) Doll, Feddes Repert., 84: 21 (1973)]

Morphology. Usually small plants, up to 10(–12) cm tall, older specimens with a tunic. Petioles pale purplish, narrowly winged. Leaves greyish green, dull, sparsely hairy. Lateral lobes 3–5, opposite to remote, of inner leaves patent, from wide base abruptly narrowed and generally slightly

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Figure 1. Herbarium specimens of *Taraxacum danubium* from Skały Twardowskiego (Kraków), leg. M. Wolanin, 29.04.2013. Scale bar = 5 cm.

widening at the apex part, of outer leaves recurved and obtuse at the apex, entire or occasionally with a few small teeth at margin; interlobes often with teeth; terminal lobe of outer leaves triangular, obtused, of inner leaves triangular, often with a distinct short and obtuse tip. Scapes as long as or slightly longer than leaves, reddish/purplish, sparsely hairy in the upper part. Outer bracts greyish green, quite often suffused purple, regularly spreading to quite regularly arranged and recurved, $4-6 \times 1.5-2.5$ mm, lanceolate, narrowly bordered: 0.1 (–0.2) mm, recurved at apex, corniculate. Capitulum yellow, 2–3 cm in diameter, ligules with greyish brown-red stripes, styles exerted, stigma grey-green. Pollen present. Achenes dark brown-red, 3.3–3.8 mm (incl. cone), cone 0.7–1.0 mm, achene body densely spinulose above.

General species range. It is a Central European species reported till now in the Czech Republic, Hungary, Austria, Slovakia and also in North-Eastern Germany in Berlin (UHLEMANN 2003; KIRSCHNER et al. 2011).

Distribution in Poland. It is a rare species in Poland, found only in the Kraków-Częstochowa Upland (Fig. 2).

Chromosome number. Karyological analysis showed triploid chromosome number $2n = 3x = 24$ (Fig. 3a). It agrees with data for plants from the Czech and Slovak populations (VAŠUT 2003; RICHARDS 1970; MÁRTONFIOVÁ et al. 2010).

Habitat. In Poland, *Taraxacum danubium* grows mostly on dry sandy soils covering calcareous rocks, more rarely on calcaric leptosols in rock crevices and ledges. Floristic composition of plant communities shows a predominance of species characteristic of the *Sedo-Scleranthetea* and *Festuco-Brometea* alliances such as *Dianthus carthusianorum*, *Phleum phleoides*, *Potentilla arenaria*, *Centaurea stoebe*, *Thymus pulegioides*, *Sedum acre*, *Sedum sexangulare*, *Veronica spicata*, *Koeleria macrantha*, *Silene otites*, *Cerastium semidecandrum*, *Artemisia campestris*, *Carex caryophyllea*, *Scabiosa ochroleuca*.

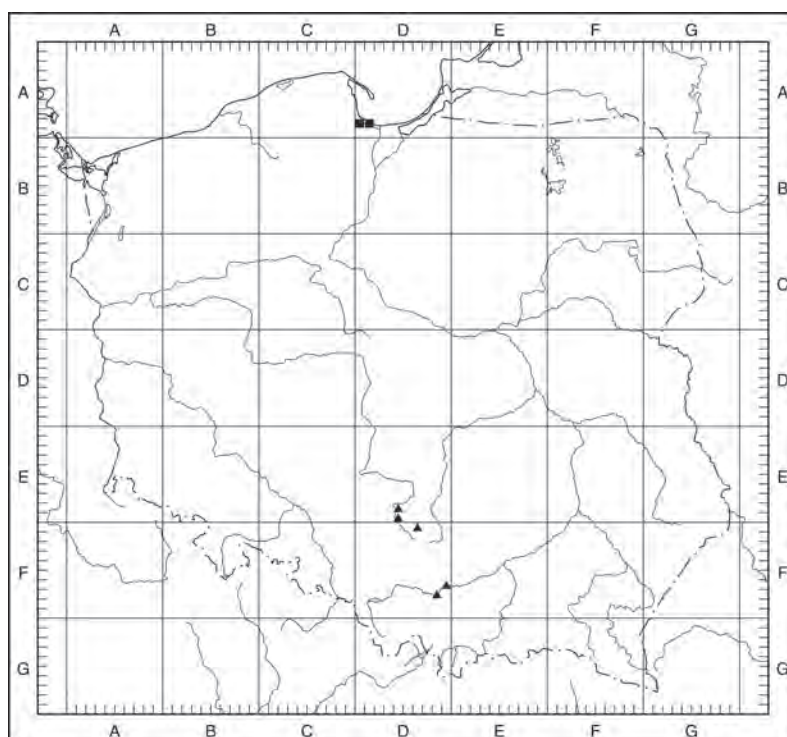


Figure 2. Distribution of *Taraxacum danubium* (▲) and *T. tortilobum* (■) in Poland (ATPOL square unit – 10 × 10 km).

Examined specimens. DE84: Olsztyn, N 50°44'59.9", E 19°16'47.7", rock in the vicinity of the castle, leg. M. Wolanin, 13.04.2014; DE94: Sfinks Hill, N 50°44'15.0", E 19°16'17.6", xerothermic grassland, leg. M. Wolanin, 12.04.2016; DF06: Mirów, N 50°36'50.8", E 19°28'30.4", grassland near the castle, leg. M. Wolanin, 14.04.2014; DF69: Kostrze (Kraków), N 50°02'19.3", E 19°52'09.7", old quarry, leg. M. Wolanin, 19.04.2015; Skały Twardowskiego (Kraków), N 50°02'27.8", E 19°54'15.7", xerothermic grassland, leg. M. Wolanin, 29.04.2013; Pychowicka Górka (Kraków), N 50°01'50.9", E 19°53'00.1", xerothermic grassland, leg. M. Wolanin, 29.04.2013; Kostrze/Pychowice, dry hill, leg. H. Trzcińska-Tacik, 27.04.1957 (KRA 0378960); Pychowice near Kraków, calcareous rocks, leg. A. Jasiewicz, 27.04.1954 (KRA 0155140); calcareous hills near Pychowice, leg. T. Tacik, 08.05.1953 (KRAM 387179); DF78: Podgórk Tynieckie-Biedzina, calcareous hill, leg. T. Tacik, 27.04.1951 (KRAM 387180).

Note. TACIK (1980) and MIREK et al. (2002) mention a similar species *T. austriacum* Soest (= *T. erythrospermum* Andr. ex Besser) from Poland. However, herbarium specimens of this taxon, collected by Prof. Tadeusz Tacik in the last century from the vicinity of Kraków (Pychowice, Tyniec), have been verified by us as *T. danubium*. Distinguishing features useful for the identification of these taxa are summarized in Table 1.

Taraxacum erythrospermum is a diploid species found in the south-western and the south-eastern part of Europe, i.e. the Iberian Peninsula, Southern France, Switzerland, the Pannonian Basin, the Balkan Peninsula, South-Western Ukraine (DEN NIJS 1997; VAŠUT 2003). We failed to confirm its occurrence during many years of our observations, and in all likelihood this species does not occur in Poland.

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Table 1. Main features distinguishing *Taraxacum erythrospermum* and *T. danubium*.

Character	<i>T. erythrospermum</i>	<i>T. danubium</i>
Somatic chromosome number/ploidy	16/2x	24/3x
Outer bracts	adpressed, rarely suberect	regularly spreading to quite regularly arranged and recurved
Outer bract margin width	(0.1–)0.3(–0.5) mm	0.1(–0.2) mm
Pollen grains	not varying in size	varying in size

***Taraxacum tortilobum* Florstr., Acta Soc. F. Fl. Fenn., 39(4): 11 (1914); Fig. 4.**

Morphology. Small to middle size plants, up to 15(–20) cm tall, tunic present. Petioles pale red-purplish, narrowly winged. Leaves greyish green to light green, almost glabrous. Lateral lobes 4–6, patent or recurved, widened at the base, crisped, with numerous filiform-teeth, at the apex part usually curled; interlobes frequently dentate; terminal lobe with a tongue-shaped tip. Scapes as long as leaves, green or suffused pale red-purplish, somewhat hairy. Outer bracts grey-green, usually suffused with purple, loosely adpressed to obliquely spreading, 6–7(–8) × (1.5)2–3 mm, ovate to lanceolate, narrowly bordered (0.1(–0.2) mm), strongly purple at apex, corniculate. Capitulum pale yellow, 3–4 cm in diameter, ligules with grey-purple stripes, styles exerted, stigma grey-purple. Pollen present. Achenes pale grey-brown, strongly crisped, 4.7–5.3 mm (incl. cone), cone 1.4–1.9 mm (for specimens growing in full light 4.0–4.4 mm, cone 0.9–1.3 mm), achene body spinulose above.

General species range. It is a mostly West European species. Most of its localities were reported in the Netherlands and Belgium. Moreover, this species is quite common in Northern France, South-Western Germany and Switzerland. Towards the south, the species range extends to Corsica, and towards the west it reaches the north-western coast of France. It is also reported in the south-eastern part of the United Kingdom (ADEMA et al. 1982). RICHARDS (1969) cites *T. tortilobum* from the north-western coast of Spain. In the surroundings of the Baltic Sea, this species was noted from few localities in Germany, Denmark, Sweden, Finland, Estonia and Latvia (ADEMA et al. 1982).

Distribution in Poland. *Taraxacum tortilobum* was recorded only in Gdańsk (Fig. 2).

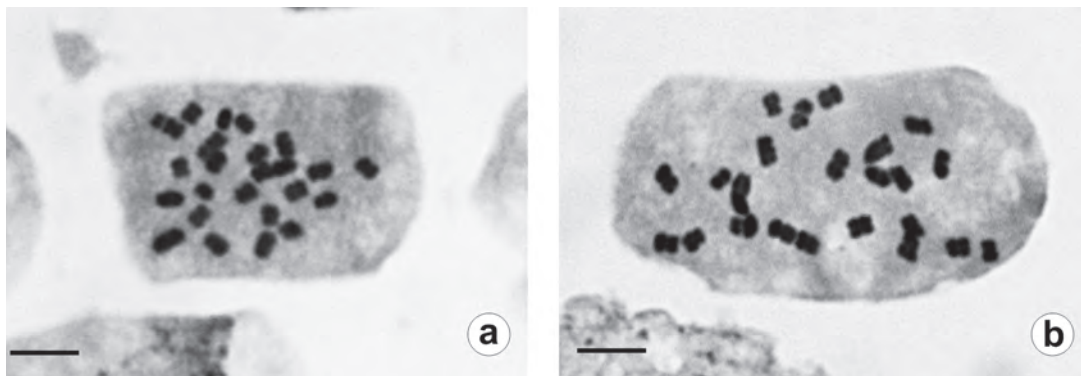


Figure 3. Mitotic chromosomes of *Taraxacum danubium* (a), $2n = 3x = 24$ and *T. tortilobum* (b), $2n = 3x = 24$. Scale bars = 5 μ m.

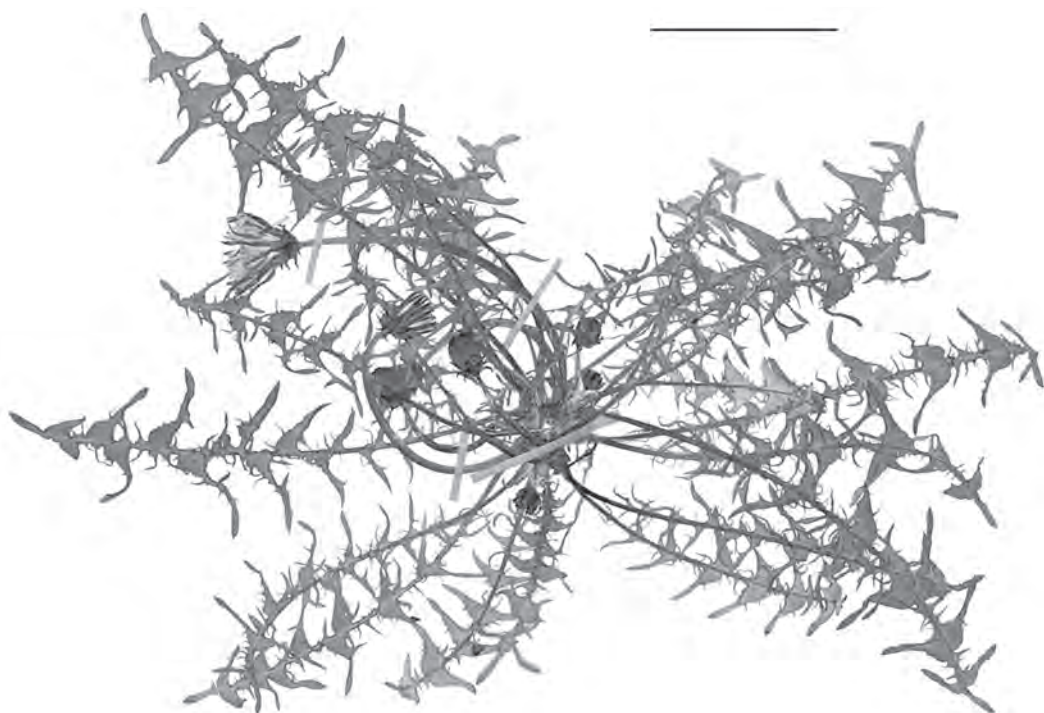


Figure 4. Herbarium specimen of *Taraxacum tortilobum* from Stogi (Gdańsk), leg. M. Wolanin, 08.05.2016. Scale bar = 5 cm.

Chromosome number. Karyological analysis showed triploid chromosome number $2n = 3x = 24$ (Fig. 3b), which corresponds to the data of Western European populations of this species (HOU-LIU 1963; RICHARDS 1969; DOLL 1973; UHLEMANN 2000). However, an aneuploid chromosome number $2n = 25$ was also given for plants from Spain (RICHARDS 1969).

Habitat. In Gdańsk, *Taraxacum tortilobum* grows on dry sandy soils, mostly in semi-ruderal slightly shadowy places. The most numerous population of this species was found on a sandy path at the edge of pine forest in community with *Elymus repens*.

Examined specimens. DA80: Gdańsk, Roland pleasure ground, N 54°24'45.2", E 18°36'18.1", lawn on sandy ground, leg. M. Wolanin, 08.05.2016; DA81: Stogi (Gdańsk), N 54°22'08.1", E 18°43'31.8", loosely turf on sand, leg. M. Wolanin, 08.05.2016; Stogi (Gdańsk) N 54°22'27.1", E 18°43'40.4", sandy pathside on the edge of a pine forest (along the concrete sidewalk), leg. M. Wolanin, 07.05.2016.

Note. *Taraxacum tortilobum* is included in the *Dissimilia* group on the basis of straw-coloured achenes. It is easily distinguished from other species belonging to section *Erythrosperma* by a combination of pale grey-brown achenes, leaves strongly crisped and toothed and lateral lobes usually curled (WENDT & ØLLGAARD 2015).

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