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Taraxacum koksaghyz Rodin definitely is not an example of overcollecting in the past. A reply to S. Volis et al. (2009)

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Summary

Conclusions presented by VOLIS et al., J. Appl. Bot. Food. Qual. 83, 60-63 (2009) are shown to be incorrect. VOLIS et al. consider *Taraxacum koksaghyz* as a rare species as a result of overcollecting in the past. It is shown in the present paper that VOLIS et al. explored the Kazakhstan localities in a wrong part of the season and not at the habitats belonging to the ecological optimum of the species. *Taraxacum koksaghyz* is documented here as a relatively common species at suitable habitats within its whole known range, a list of populations studied is given and the species is briefly characterized.

Introduction

The Russian dandelion, *Taraxacum koksaghyz* Rodin[1], was cultivated as a rubber crop in the Soviet Union in the 1930's to the 1950's. It is native to the eastern Kazakhstan where it is reported to grow in the valleys of the Tian Shan Mountains in an area comprising some 10 000 square km. The number of wild plants occurring in this area was once estimated to be some 600 million (POLHAMUS, 1962). VOLIS et al. (2009) published a paper analyzing the current condition of the populations of *Taraxacum koksaghyz* Rodin in eastern Kazakhstan, as a result of two expeditions to that area undertaken in 2005 and 2006. VOLIS et al. (2009) found this species to be extremely rare in that area now and drew a tentative (questionmarked) conclusion that the rarity of *T. koksaghyz* was a result of mass overcollecting in the past.
As we can demonstrate that the above conclusions are incorrect, we decided to write a brief information note as a reply to VOLIS et al. (2009).

Background

Most of the introductory historical facts are given in VOLIS et al. (2009), and we can only add a few references to complete the picture (LIPSCHITZ, 1934; WHALEY and BOWEN 1947; ULMANN, 1951; POLHAMUS, 1962). We can summarize that the popularity of *T. koksaghyz* in the 1940's in countries like the USA, Germany, UK, Australia, Sweden, Finland, Spain etc. was a result of a very difficult accessibility of the *Hevea* rubber during the World War II. Nowadays, the increasing demand for high quality natural rubber, natural threats for the *Hevea* rubber production and potential health risks in using *Hevea* rubber again focus the applied research interest on possible alternatives (*Parthenium argentatum* A. Gray and *Taraxacum koksaghyz* Rodin) (VAN BEILEN and POIRIER 2007).
In order to meet the above challenges, a consortium of institutions and companies was formed and an integrated project launched (EU-PEARLS is the acronym of the project title: EU-based Production and Exploitation of Alternative Rubber and Latex Sources, see also http://www.eu-pearls.eu/uk/). Initial efforts of the consortium concentrated on the germplasm to be exploited. It turned out that the germplasm cultivated in botanical gardens or preserved in germplasm collections under the name of *T. koksaghyz* either is not useful for our research or is not available. Thus, in 2008 and 2009 two expeditions were organized to re-explore the river valleys in the mountains of the eastern Kazakhstan (all the main valleys with historical records of *T. koksaghyz* were visited, i.e., the Kegen Basin, the Sarydzhaz Basin, the Tuzkol Lake Basin and the Tekes Basin, from west to east). This area includes the regions that were surveyed by Volis et al. 2-3 years before our visit.

Taraxacum koksaghyz – its basic features

Agamospermy versus sexuality is the main issue of the *Taraxacum* taxonomy (VAN DIJK and BAKX-SCHOTMAN 2004; KIRSCHNER and ŠTĚPÁNEK, 1994). Coexistence of various reproduction strategies, a common sympatric occurrence of several taxa, hybridization and morphological plasticity are responsible for the taxonomic complexity of the genus. Without a cautious approach and experience it is difficult to understand the taxonomic structure in *Taraxacum*. It is therefore absolutely essential to identify the reproduction system of the material studied. *Taraxacum koksaghyz* from all our localities, in accordance with the literature data, was found diploid (with a confirmation of 2n=16 from selected sites) and sexual, with a predominant self-incompatibility. As regards the taxonomic position and morphological features, we refer to KIRSCHNER and ŠTĚPÁNEK (2008) and to SCHISCHKIN and TZVELEV (1964). The most conspicuous morphological features of *T. koksaghyz* are fleshy, glaucous grey-green leaves usually with obtuse lobes or entire, at least some of them being appressed to the ground, involucre very narrow at the base, outer involucral bracts erect, linear-lanceolate to lanceolate, with acute green horns to 2.5 (-4) mm long at the apex, inner bracts with horns to 1.7-2.0 mm long, stigmas pure yellow, pollen grains of regular size, achenes thin, 0.7-0.9 mm wide, 2.8-3.8 mm long.

Results

At suitable habitats in all the above regions, *T. koksaghyz* was found a relatively common, locally very common species. Tab. 1 shows estimated population sizes at the localities visited. Results of genetic analyses (VAN DIJK et al., in prep.) do not indicate any depauperation in the genetic variation within regions.
Taraxacum koksaghyz finds its ecological optimum in an ecotonal habitat between wet saline meadows close to shrubby vegetation of *Caragana suffruticosa* and *Lonicera albertii*, with taxa such as *Taraxacum bessarabicum* and *Triglochin maritimum*, and between dry stands of *Achnatherum splendens*. It is almost absent from the wet side of this gradient but locally frequent in the drier wing of habitats. A characteristic vegetation can be illustrated by the following phytosociological record from the Sarydzhaz Basin:

A loose group of *Achnatherum* tufts with *T. koksaghyz* in the shelter (2 x 2 m, coverage 75%, exposure 0): *Achnatherum splendens* 3-4, *Koeleria* sp. r, *Taraxacum koksaghyz* 1-2, *Lappula microcarpa* +, *Androsace* cf. *ovczinnikovii* +, *Artemisia* cf. *schrenkiana* +-1, *Potentilla angustiloba* +, *Convolvulus lineatus* r, *Festuca pseudovina* r, *Elymus* cf. *dahuricus* +.

[1] The original hyphenated orthography of the name, *T. kok-saghyz*, is corrected in accordance with the ICBN, Art. 60.9. The spelling to be followed is *T. koksaghyz*

Tab. 1: Localities with *T. koksaghyz* and the estimated population size.

Region / Locality Name	Altitude	Population size (ca.)
A. Tekes Basin		
Oy-Kain, 4-5 km SE of Tekes	1760 m	5,000
Tekes, N side, 1 km N, alluvium of Tekes river	1780 m	3,000
Kainar, 1 km S	1830 m	1,000
B. Tuzkol lake Basin		
Tuzkol lake, NW shore	1970 m	>> 10,000
C. Sarydzhaz Basin		
Sarydzhaz, W margin of the village	1920 m	500
Sarydzhaz, 2 km N	1895 m	2,000
Sarydzhaz, 3 km N	1880 m	3,000
between Karabulak river and Sarydzhaz	1875 m	>> 10,000
between Sarydzhaz and Kegen river	1877 m	5,000
Komirshi, 5 km SW	1890 m	3,000
Komirshi, near bridge across Kegen river	1862 m	100
Sarydzhaz, 4 km ENE	1905 m	10,000
Sarydzhaz, 4-5 km NE	1880 m	100,000 !
Karasaz, 1 km W	1900 m	< 10
Karasaz, 0.5 km NW	1925 m	> 5,000
between Karasaz and Sarydzhaz, 7 km ENE of Sarydzhaz	1885 m	1,000
between lake Tuzkol and Karasaz, 4 km E of Karasaz	1955 m	100
Karasaz, 1.5 km SE	1944 m	500
near bridge across Ulken-Karasu	1935 m	100
D. Kegen Basin		
Kegen. in the village	1845 m	< 10
Kegen, 1 km SE	1835 m	> 2,000
Kegen, 1 km towards Boleksaz	1830 m	>> 10,000
Kegen, 2 km SW	1828 m	5,000
Kegen, near the river, NE of the village	1815 m	50,000
Kegen, 2 km N, towards river	1820 m	1,000
Kegen, 4-5 km N	1807 m	10,000
between Novyj Temurlik and Dzhalauly	1805 m	> 10,000
Kegen, N of the village	1815 m	< 100

Considerations on the differences between the present results and those of Volis et al. (2009)

On the basis of the information given in Volis et al. (2009), we can identify at least one major reason for the alleged rarity of *T. koksaghyz* ascertained during their expeditions in 2005 and 2006. It is the timing of the exploration. The optimum flowering and early fruit-set time is end of May or beginning of June. During the second part of the vegetation season (frequently from July to start of September) *T. koksaghyz* usually enters a rest period due to adverse growing conditions (increasing drought due to continental climate). The plant often sheds all leaves and thus becomes almost invisible to the observers (Lipschitz, 1934). The August term of observations requires a detailed search of localities and a good knowledge of the species' ecology, as we proved in August 2009. Without that, it is not easy to find the species in the field. Another factor is the description of habitats visited by Volis et al.: wet meadows screened in 2005 represent a very marginal habitat, only with occasional occurrence of *T. koksaghyz*. In 2006, Volis et al. visited a drier and more open vegetation with a certain success but their note on the coexistence of *T. koksaghyz* with many other dandelions again shows that it was not the best habitat (in many rich populations, *T. koksaghyz* is the only or at least absolutely dominant dandelion species, often parapatric or sympatric with populations of *T. brevicorniculatum* V. Korol., occasionally not far from *T. bessarabicum* (Hornem.)Hand.-Mazz. growing on wet sites, or from *T.* sect. *Dissecta* or *T.* sect. *Macrocornuta* restricted to dry places, much less frequently in the vicinity of ruderal sites with *T.* sect. *Ruderalia*). Thus a combination of the unfavorable part of the vegetation season and the improper habitat might have led to the erroneous conclusion of a great rarity of *T. koksaghyz*

Volis et al. (2009) reported a very low rubber content in the plants that they collected. They suggested that the rubber content of present day *T. koksaghyz* populations was lower than reported in the 1950 literature. Ruling out the possibility of misidentification of the plant material, they suggested that the reason for this might be "over collecting in general and especially of plants with high rubber content in the 1930ies to 1950ies of the last century". Volis et al. (2009) admitted that the available literature did not contain information about commercial collecting of *T. koksaghyz* in the wild. Nevertheless, they considered this highly likely. It should be mentioned here that selective collecting of plants with high rubber content is not an easy task, not even for trained plant breeders.

We determined the rubber content of our newly collected *T. koksaghyz* material, using the method described in Schmidt et al. (2010). Rubber concentration in the latex in roots varied between plants from 50 to 450 µg/µl. Since Volis et al. (2009) and the older Soviet literature used different rubber extraction methods and concentration units, the data cannot be compared directly. In addition, agricultural data produced in the Soviet Union during the Stalin era may not be reliable. We consider some of the *T. koksaghyz* plants that we collected as high rubber producers.

T. brevicorniculatum, which as stated above, often grows in the vicinity of *T. koksaghyz* also has horned bracts, although shorter and thicker than those of *T. koksaghyz*. We found that *T. breviconiculatum* contains at maximum 90 µg rubber/µl latex, which is five times less than our highest *T. koksaghyz* value. The apparent decrease in rubber content compared to the older literature could be explained if the material of Volis et al. (2009) or its part did not belong to *T. koksaghyz*. Unfortunately there is no documentation of the morphology and taxonomic status of the material used by Volis et al. (2009).

Volis et al. (2009) mention the pan-global weed *Taraxacum officinale* (common dandelion) as the only other *Taraxacum* species they found. This contrasts with the descriptions of Koroleva (1940a, 1940b) and with our own observations of several other *Taraxacum* species accompanying *T. koksaghyz*. The suggestion at the end of the paper that *T. koksaghyz* may not represent a species but a latex producing form of *Taraxacum officinale* ignores the results of older systematic and crossing studies (e.g. Koroleva, 1940a). Our ongoing investigations in the EU-PEARLS program fully support the species status of *T. koksaghyz*

Conclusion

Taraxacum koksaghyz Rodin remains a relatively common species in its known range in E. Kazakhstan, as satisfactorily proven by the expeditions in 2008 and 2009 and the subsequent examination of the material. The suggestive conclusions of Volis et al. are based on unsatisfactory data. We believe that this is an example of the importance of good knowledge of the ecology and the taxonomy of a plant group under study, particularly in the case of economic botany.

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