Tragopogon abbreviatus (Asteraceae): a little-known species inferred from morphological and molecular analysis

Kamil ÇOKUNÇELEBİ1*, Mutlu GÜLTEPE2, Murat Erdem GÜZEL1, Serdar MAKBUL3
1Department of Biology, Faculty of Science, Karadeniz Technical University, Trabzon, Turkey, 2Department of Forestry, Dereli Vocational School, Giresun University, Giresun, Turkey, 3Department of Biology, Faculty of Arts and Sciences, Recep Tayyip Erdoğan University, Rize, Turkey

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Abstract: Tragopogon porrifolius occurs in Turkey with 3 taxonomically confused subspecies: T. porrifolius subsp. eriospermus, T. porrifolius subsp. longirostris, and T. porrifolius subsp. abbreviatus. In the present paper, T. porrifolius subsp. abbreviatus endemic to Turkey is raised at specific level based on morphological and molecular analysis. After detailed assessment of original herbarium specimens and literature studies, we found that this name is not typified yet. Thus, a lectotype is provided together with an emended diagnosis; synonym, distribution map, and conservation status for the first time. Additionally, a preliminary phylogenetic position of this little-known taxon is given on several newly sequenced data.

Key words: Cichorieae, lectotypification, nuclear sequence data, Tragopogon longirostris, T. porrifolius, Turkey

1. Introduction

Tragopogon L. (Asteraceae) includes about 150 species native to Eurasia and known as salsify worldwide (Bremer, 1994; Soltis et al., 2004) and 22 species (25 taxa) in Turkey (Coşkunçelebi et al., 2017). Members of this genus are known as Yemlik or Tekesakalı in Turkish (Güner et al., 1994; Soltis et al., 2004) and 22 species (25 taxa) in Turkey (Matthews, 1975). Further comparisons based on several morphological features that are important for the preparation of the Turkish Tragopogon account, this account does not always coincide with current published accounts of the genus Tragopogon (Feinbrun-Dothan, 1978; Dimopoulos et al., 2016). Greuter (2003) transferred T. longirostris under T. porrifolius as subspecies (T. porrifolius subsp. longirostris (Sch. Bip.) Greuter), however he ignored the names T. longirostris var. abbreviatus in his paper about the Euro+Med treatment of Cichorieae (Compositae).

During a taxonomic revision of the Turkish Tragopogon, the authors collected several specimens easily keying out T. longirostris var. abbreviatus according to the Flora of Turkey (Matthews, 1975). Further comparisons based on several morphological features that are important for the genus Tragopogon (Blanca and Diaz De La Guardia, 1997; Sukhorukov and Nilova, 2015) revealed that these samples distinctly differ from T. porrifolius subsp. longirostris (=T. longirostris var. longirostris) and T. porrifolius subsp. eriospermus (Ten.) Greuter (=T. porrifolius var. brachyphyllum Boiss.). Although T. longirostris and T. porrifolius (=T. porrifolius var. brachyphyllum Boiss.) were treated as separate species by Matthews (1975) in the Flora of Turkey, Coşkunçelebi and Gültepe (2012)
transferred *T. longirostris* var. *abbreviatus* under the *T. porrifolius* as a subspecies (*T. porrifolius* subsp. *abbreviatus* (Boiss.) Coşkunç. and M.Gultepe) contrary to Greuter (2003). Besides Gültepe et al. (2016) reported, contrary to Greuter (2003), that *T. porrifolius* and *T. longirostris* should be treated as separate species based on molecular data. Correspondingly, the aim of the present study is to identify the authentic material of the name *T. longirostris* var. *abbreviatus* and ascertain its taxonomy and provide a preliminary phylogenetic position of this little-known species.

2. Materials and methods

2.1. Morphological studies

The current study was mainly performed on authors’ own specimens preserved in Herbarium of Biology Department at Karadeniz Technical University (KTUB) as well as herbarium specimens from the following herbaria (ANK, B, E, EGE, G, GAZI, HUB, ISTE, ISTF, ISTO, KATO, KNYA, LE, TBI, VANF). Detailed locality information of the examined specimens is given in the Appendix. Herbarium acronyms are given according to Index Herbariorum (Thiers, 2019).

All specimens were identified according to the Flora of Turkey (Matthews, 1975), and nomenclature is given according to Coşkunçelebi and Gültepe (2012). Morphological characters were measured from specimens according to Boisser (1875), Matthews (1975), Gültepe (2014), and relevant literature (Borisova, 1964; Richardson, 1976; Rechinger, 1977). All measurements and observations were performed from at least 3 specimens. Outer mature achenes, phyllaries, fruiting, and flowering capitula obtained from herbarium specimens stored at KTUB were drawn and/or photographed under the stereo microscope.

2.2. Red list assessment studies

The threat category has been assessed according to the red list criteria of IUCN (2012) using area of occupancy (AOO), the extent of occurrence (EOO), population numbers, and field observations. A distribution map, calculation of the EOO (km²), and AOO (km²) were carried out by using Geo-Cat (Bachman et al., 2011).

2.3. Molecular studies

Genomic DNAs were extracted from silica-dried leaves following the modified extraction procedure of Doyle and Doyle (1987). Amplification and sequence of nrDNA ITS regions were carried out according to Gültepe et al. (2010). Phylogenetic analyses were performed on the ITS data set consisting of 87 accessions (Table 1), of which 15 were newly generated sequences, 72 sequences were obtained from GenBank and 10 were used as an outgroup provided from Gültepe et al. (2016). For each taxon, multiple samples were used whenever possible to observe the infra-specific DNA sequence variation and construct a robust phylogenetical analysis. All sequences (85 accessions) were aligned with Bioedit v. 7.0 (Hall, 1999). Phylogenetic relationships were reconstructed using Maximum Parsimony (MP) and Bayesian Inference (BI) analyses. MP analyses were run in PAUP* version 4.0b10 (Swoford, 2003) using heuristic search with the following parameters: all characters have equal weight, gaps are regarded as ‘missing’, simple addition of sequences, TBR branching swapping, maxtrees setting to 100 and auto-increased by 100, one nonbinary starting tree arbitrarily dichotomized before branch swapping, only one tree was saved. A majority rule consensus tree was calculated from the most parsimonious trees. Jackknife (JK) support values for the nodes found in the MP analysis were calculated in PAUP* applying the optimal jackknife parameters according to Farris et al. (1996) and Müller (2005) with the following parameters: 10,000 jackknife replicates using the TBR branch swapping algorithm with 36.788% of characters deleted and one tree held during each replicate. Prior to BI analyses, the nucleotide substitution model that best fits the datasets was determined for ITS with MrModeltest 2.3 (Nylander, 2004), following the Akaike Information Criterion (AIC). BI analyses in MrBayes 3.2 (Rouquist et al., 2012) were performed with 4 simultaneous runs of Metropolis-coupled Markov Chains Monte Carlo (MCMC/MCMC), each with 4 parallel Markov chains. Each chain was performed for 20 million generations and, starting with a random tree, one tree was saved every 10000th generation. For other parameters, the default settings of the program were left unchanged. A conservative burn-in of 0.2 (i.e. discarding the first 20% of the trees) was applied. The remaining trees were used to generate a majority-rule consensus tree, and visualized in TreeGraph v.2 (Stöver and Müller, 2010).

3. Results

3.1. Taxonomy

*Tragopogon abbreviatus* (Boiss.) Coşkunç. & M.Gultepe, *comb.&stat. nov.* (Figure 1)

*Basionym:* *Tragopogon longirostris* var. *abbreviatus* Boiss., Fl.Orient. 3.745 (1875).

*Synonym:* *Tragopogon porrifolius* subsp. *abbreviatus* (Boiss.) Coşkunç. and M.Gultepe, Türkiye Bitkileri Listesi (Damarlı Bitkiler), 212 (2012), *syn. nov.*

*Lectotype* (designed here): Turkey/B2 Manisa: Alaşehir (“*Tmoli subra Philadelphianum*”) Boisser s.n (G00330030!).

*Residual syntypes:* C1 Aydın, Aydın Dağı (“in regione subalpina montis Mesogis supra Tralles”), Boisser s.n. (G00330034!), B2 Manisa: Alaşehir (“*Tmoli pars superior Alaşehir*”), Boisser s.n. (G00330029!), A8 Gümüşhane,
Table 1. Locality information of the taxa using in phylogenetic analysis based on the present (*) and GenBank (**) accessions. MJ: majority-rule consensus tree.

| Taxa                          | Voucher                                      | Code used in the MJ |
|-------------------------------|----------------------------------------------|---------------------|
| *T. afghanicus* Boiss.        | *M. Ownbey 274243 (WS)                       | **AY508175**        |
| *T. albinervis* Freyn & Sint.| V. A. Matthews s.n. (K)                      | **AY508183**        |
| *T. armeniacus* Kuth.         | *A. Chechurov s.n. (LE)                      | **AY645803**        |
| *T. aureus* Boiss.            | A. Khochrjakov s. n. (MHA)                   | **AY645804**        |
| *T. balcanicus* Velen.        | A. Khochrjakov s.n. (MHA)                    | **AY645805**        |
| *T. bornmuelleri* Ownbey & Rech. f. | *K. H. Rechinger 1507 (K)               | **AY645806**        |
| *T. brevirostris* DC.         | 261641                                       | **AY508174**        |
| *T. coelesyriacus* Boiss.     | USA, *M. Ownbey 274106 (WS)                   | **AY645809**        |
| *T. collinus* DC.             | N. *Tzvelev s.n. (K)                          | **AY645810**        |
| *T. coloratus* C.A.Mey.       | E. Nazarova s. n. (ERE)                      | **AY645811**        |
| *T. cretaceus* S.A.Nikitin   | *Tzvelev N. N.*                              | **HQ456271**        |
| *T. crocifolius* L.           | *M. Ownbey 274740 (WS)                       | **AY508180**        |
| *T. cupanii* DC.              | Italy, G. Caruso                             | **KF050386**        |
| *T. cupani* DC.               | USA, *M. Ownbey 274133                       | **EF374138**        |
| *T. dasyrhynchus* Artemczuk   | Russia, E. Mavrodiev field collection,       | **AY645812**        |
| *T. dshimilensis* K.Koch      | Turkey, Çoşkunçelebi & Gültepe 301           | *CG301*             |
| *T. dubjanskyi* Krasch. & S. A. Nikitin | South Russia, E. Mavrodiev                  | **AY645814**        |
| *T. dubius* Scop.             | *M. Ownbey 274197 (WS)                       | **AY645813**        |
| *T. elongates* S.A.Nikitin   | V. *Bochkin & I. Rusanovich s. n. (MHA)    | **AY645815**        |
| *T. fibrosus* Freyn & Sint.  | A. Khochrjakov s.n. (MHA)                    | **AY645816**        |
| *T. filifolius* Boiss.        | A. Grosshejm s. n. (LE)                      | **AY645817**        |
| *T. graminifolius* DC.        | I.A. Gubanov and P. Meshherjakov (LE 381)   | **KF050411**        |
| *T. hayekii* (Soó) I. Richardson | I. B. K.Richardson 175685 (WS)               | **AY645818**        |
| *T. heterospermus* Schweigg.  | A. Skvortzov s. n. (MHA)                     | **AY508168**        |
| *T. jesianus* Boiss. & Buhse  | I. Gubanov & V. Pavlov s. n. (MW)           | **AY645819**        |
| *T. kemulariae* Kuth.         | E. Nazarova s. n. 34564E (ERE)              | **AY645820**        |
| *T. kindingeri* Adamović      | *M. Ownbey 251956 (WS)                       | **AY508178**        |
| *T. kotschyi* Boiss.          | K. H. Rechinger s.n. (K)                     | **AY508181**        |
| *T. krascheninnikovii* S. A. Nikitin | S. *Kuthatheladze s. n. (LE)               | **AY645821**        |
| *T. lamottei* Rouy            | F. *Valle & G. Blanca* field collection       | **AY645823**        |
| *T. lattifolius* Boiss. var. angustifolius | Turkey, Çoşkunçelebi & Gültepe 62 (Dogan et al. 2014) | *CG62*             |
| *T. longifolius* Boiss.       | F. *Valle & G. Blanca* field collection       | **AY645824**        |
| *T. longirostris* Sch. Bip.   | USA, *M. Ownbey 274106 (WS)                   | **AY508185**        |
| *T. longirostris* Sch. Bip. var. longirostris | Turkey, GAT-bg250                           | **AJ633502**        |
| *T. makaschwili* Kuth.        | S. *Kuthatheladze s. n. (LE)                 | **AY645826**        |
| *T. marginatus* Boiss. & Buhse | S. *Kuthatheladze s. n. (LE)               | **AY645827**        |
| *T. meskheticus* Kuth.        | D. *Sosnovsky s. n. (LE)*                   | **AY645828**        |
| *T. minor* Mill.              | 1373086 (USN)                                | **AY508184**        |
| *T. mirus* Ownbey             | USA, 2602 Palouse, WA                        | **AY458587**        |
| *T. mirus*                    | F.H. Montgomery, W. Shumovich               | **MG220248**        |
| *T. montanus* S. A. Nikitin   | K. H. Rechinger s.n. (K)                     | **AY508172**        |
| *T. nachitschevanicus* Kuth.  | Azerbaijan, s.n. (LE)                        | **KF050432**        |
| Taxon                  | Collection Details                        | Accession Number |
|-----------------------|------------------------------------------|-----------------|
| T. orientalis         | L. Turkey, Coşkunçelebi & Gültepe 483    | **AY508170      |
| T. olympicus          | Boiss.                                   | **AY645829      |
| T. podolicus          | (DC.) S. A. Nikitin                      | **AY465831      |
| T. porrifolius        | L. s.l.                                   | **EF374149      |
| T. porrifolius        | s.l. USA, 25954 (WS)                     | **EF374152      |
| T. porrifolius        | s.l. USA, 291688 (WS)                    | **EF374154      |
| T. porrifolius        | s.l. USA, 37281 (KANU)                   | **EF374158      |
| T. porrifolius        | s.l. USA, 152714 (KANU)                  | **EF374161      |
| T. porrifolius        | s.l. United Kingdom, Cultivated. Mammoth. Unwins Seeds Ltd. | **EF374168 |
| T. porrifolius        | s.l. Spain, J. G. A. Reader, Botanical Museum (O) | **EF374172 |
| T. porrifolius        | s.l. Sweden, A. Nordstrom s.n.           | **EF374178      |
| T. porrifolius        | s.l. Turkey, G. Bocquet 2341             | **EF374184      |
| T. porrifolius        | s.l. USA, Solitis and Solitis collections 2611-2 | **EF374209 |
| T. porrifolius        | s.l. Canary Islands, M. Ownbey 427 (WS)  | **EF374210      |
| T. porrifolius        | L. subsp. abbreviatus (Boiss.) Coşkunç, & M. Gültepe | *CG184 |
| T. porrifolius        | subsp. abbreviatus                       | *CG188          |
| T. porrifolius        | subsp. abbreviatus                       | *CG302          |
| T. porrifolius        | subsp. abbreviatus                       | *CG337          |
| T. porrifolius        | subsp. abbreviatus                       | *CG345          |
| T. porrifolius        | L. subsp. australis                      | *CG342          |
| T. porrifolius        | L. subsp. eriospermus (Ten.) Greuter     | *CG345          |
| T. porrifolius        | subsp. eriospermus                       | *CG348          |
| T. porrifolius        | subsp. eriospermus                       | *CG346          |
| T. porrifolius        | L. subsp. longirostris (Sch.Bip.) Greuter | *CG168          |
| T. porrifolius        | subsp. longirostris                      | *CG69           |
| T. porrifolius        | subsp. longirostris                      | *CG122          |
| T. pratensis          | L. USA, M. Ownbey 208347 (WS)            | **AY508167      |
| T. pterocarpus        | DC. Azerbaijan, E. Nazarova (LE)         | **EU124006      |
| T. pterodes           | Petrović                                 | *CG52           |
| T. pusillus           | M. Bieb. S. Liptsits s. N. (LE)          | **AY465830      |
| T. rechingeri         | Ownbey                                   | **EU391835      |
| T. reticulatus        | Boiss. & Huet. E. Nazarova 907 (ERE)     | **AY645832      |
| T. ruber              | S. G. Gmel. Russia, E. Mavrodiév Field Collection | **AY645833 |
| T. ruthenicus         | Krasch. & S. A. Nikitin Russia, E. Mavrodiév Field Collection | **AY645834 |
| T. samaritanii        | Boiss. M. Ownbey 274420 (WS)             | **AY645835      |
| T. segetus            | Kuth. T. Popova s. n. (LE)               | **AY465836      |
| T. serotinus          | Sosn. S. Kuthatheladze s. n. (LE)        | **AY465837      |
| T. simuatus           | Avé-Lall. USA, M. Ownbey 274232 (WS)     | **EF374224      |
| T. simuatus           | M. Ownbey 274442 (WS)                    | **EF374221      |
| T. simuatus           | M. Ownbey 27433 (WS)                     | **AY465838      |
| T. sosnowskyi         | Kuth. Caucasus 1830 det S. Kuthatheladze s. n. (LE) | **AY465839 |
| T. tommasinii         | Sch. Bip. M. Ownbey 274702 (WS)          | **AY645842      |
| T. trachycarpus       | S.A. Nikitin I. A. Gubanov s.n. (MW)     | **AY508177      |
| T. undulatus          | Jacq. N. K. Schvedchikova s. n (MW)      | **AY508171      |
uncultivated areas ("champs incultes à Gumusch-khané"), Bourgeau 403 (G00330032!).

**Emended description**

Sparsely floccose to glabrous, biennial 24–92 cm tall, stem branched, base of stem without fibrous leaf remains. Cauline leaves 3.5–33 × 0.25–1.0 cm, linear or linear to lanceolate with flat margin; basal leaves 3.5–35 × 0.20–0.5 cm, linear with flat margin. Peduncles thickened below capitula, involucre sparsely floccose or not. Phyllaries 8, 20–35 × 1.8–4.0 mm in flower and 38–60 × 3.0–8 mm in fruit, lanceolate, acute, longer than flowers. Ligules purple, 19–24 mm long. Achenes (with beak) 19–35 mm long, with 5 longitudinal rows of separate scales and 5 rows of shorter scales between; beak sulcate and 9–19 mm long, equally or longer than achene body and clavate at apex. Pappus 20–30 mm long, pale greyish-brown or straw colour, annulus hairy.

**Phenology:** Flowering in April–July, fruiting in May–July.

**Habitat:** *T. abbreviatus* grows in cultivated fields, roadside, graveyards, hill side, and under *Pinus brutia* Ten. Forest between 170 and 1150 m above sea level.

**Chorotype:** Endemic to Turkey

**Distribution:** North, west and south-west of Turkey (Figure 2).

**Vernacular name:** Çayır yemliği (Güner at al., 2012)

**Lectotypification**

After critical examinations on specimens and literature study, we found that the name *T. longirostris* var. *abbreviatus* has not been typified up to now according to ICN, Article 9.2 (McNeill et al., 2012). Although Boissier (1875) included 7 specimens in the protologue, further examination revealed that 4 of them belong to *T. longirostris* var. *abbreviatus*, 1 specimen belongs to *T. dshimilensis* and 1 specimen to *T. longirostris* var. *brachyphyllum*. In the present study, the sheets stored at G are being taken into account while typifying *T. longirostris* var. *abbreviatus* (= *T. abbreviatus*). Authentic specimens stored at G are now available online via JSTOR Global Plants (JSTOR, 2019). All characteristics of Boissier’s specimens (G00330029!, G00330030!, G00330032!, G00330034!) coincide with the description in the protologue. Also, there are special labels on the sheets written by either collectors or Boissier (1875). Thus, all these samples can be considered as authentic materials according to ICN, Article 9.3 (McNeill et al., 2012). However, for the specimen (G00330030!) collected from B2 Manisa: Alaşehir (“Tmoli subra Philadelpbiam”), Boissier s.n is more complete and in a better conservation status. Therefore, it has been selected as the lectotype in the present study (Figure 3).

**Key to Tragopogon abbreviatus and related species**

*T. abbreviatus* and related taxa may be inserted in the key adapted from the Flora of Turkey and the East Aegean Islands (Matthews, 1975).

4. Peduncles thickened below flowering capitula
6. Capitula 3–5 cm length; pappus purplish .... *T. coloratus*
6. Capitula (5-) 6–11 cm length; pappus greyish-brown

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**Figure 1.** *Tragopogon abbreviatus* (= *Tragopogon porrifolius* subsp. *abbreviatus*) (Çoşkunçelebi & M. Gültepe 337). a. Achene drawing. b. Fruiting capitula. c. Flowering capitula d. Phyllaries e. Achene.
7. Plant perennial, less than 12 cm .............. T. subacaulis
7. Plant annual or biennial, more than 12 cm
8. Achene beak not clavate at apex .......... T. porrifolius
8. Achene beak clavate at apex
9. Phyllaries 8, achene with 5 longitudinal rows of separate scales and 5 rows of shorter scales between .............. ................................................................. T. abbreviatus
9. Phyllaries 5–8, achene with ten longitudinal rows of short separate scales ........................................ T. longirostris

3.2. Conservation status
T. abbreviatus was recorded from more than 14 localities in Turkey (Figure 2). Each population consists of sufficient number of mature plant individuals. There is no specific threat in the habitat; the habitat is qualitatively good and far from human activities. Additionally, the AOO and EOO are 27,500 km² and 290,157 km², respectively. Thus, it should be assessed as the least concern (LC) in the present paper.

3.3. Molecular analysis
The aligned data matrix of the ITS region of rDNA (ITS1, 5.8S, ITS2) consists of 687 characters, of which 332 are constant and 205 are parsimony-informative sites including outgroups. Specimens belonging to T. abbreviatus have C and A at the position of 512 and 516, respectively. However, the rest examined Tragopogon taxa including T. porrifolius and T. colesyriacus clades consisting of nucleotides A and G at the same sites. Bayesian phylogram (majority rule consensus tree) of Tragopogon based on ITS with JK support values is presented in Figure 4. According to this phylogram, members of Tragopogon were separated from out-group (PP = 1, JK = 100) and fell in 4 distinct subgroups (PP = 1.00, JK = 100). The examined specimens treated under T. porrifolius before this study were grouped in the same clade in Subgroup I with good supports (PP = 1.00, JK = 64). However, individuals belonging to T. porrifolius subsp. eriospermus, T. abbreviatus and T. porrifolius subsp. longirostris were discriminated from each other in the phylogenetic tree.

4. Discussion
T. abbreviatus was firstly described as a variety of T. longirostris based on specimens of Boissier, Bourgeau, Calvert, and Koch collected from different parts of Turkey. Although Boisser (1875) did not specify collection details, i.e. collection date, collector number and herbarium, in the protologue, he noted that the beak of T. longirostris var. abbreviatus was scarcely longer (“rostrum achenio vix longius”), not well 2 times longer (“vel duplo longius”) as in the T. longirostris var. longirostris. The authentic material of the name is currently stored at G, but a critical examination of these specimens revealed that 4 of them (G 00330029!, G 00330030!, G 00330032!, G 00330034!) clearly belong to T. abbreviatus due to achene traits and general habitus. However, specimen collected from A8 Erzurum, Tortum (“in Armenia circa Turtum”, Calvert s.n., G [G00330031!]) differs from the rest of the cited specimens due to unbranched stem and the number of

Figure 2. Distribution map of the Tragopogon abbreviatus in Turkey.
phyllaries (6 digit), so it was identified as *T. longirostris* var. *longirostris* (=*T. porrifolius* subsp. *longirostris*) in the present study. The specimens stored at P (P 00720169 photo!) and B (B 100093737!) collected from A8 Rize: Cimil (Ponto Lazico) listed under name of *T. longirostris* var. *abbreviatus* by Matthews (1975) were identified as

Figure 3. Lectotype of *T. abbreviatus* stored at G.
Figure 4. Bayesian phylogram (majority rule consensus tree) of *Tragopogon* taxa based on ITS dataset. Support values: Bayesian posterior probability (PP) above branches maximum parsimony jackknife (JK) below branches, dashes (-) designate no supports. Purple and yellow indicate flower colours.
Tragopogon abbreviatus is morphologically related to T. longirostris var. longirostris and T. porrifolius subsp. eriospermus. Although the length of achene beak of T. abbreviatus is shorter than the closely related taxa, achene beak of T. abbreviatus (Figure 1) and T. porrifolius subsp. eriospermus (Figure 5) is straight and stout contrary to T. porrifolius subsp. longirostris (Figure 6) characterized

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**Figure 5.** *Tragopogon porrifolius* subsp. *eriospermus* (*Çoşkunçelebi & Gültepe* 178) a. Achene drawing. b. Fruiting capitula. c. Flowering capitula d. Phyllaries e. Achene.

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**Figure 6.** *Tragopogon porrifolius* subsp. *longirostris* (*Çoşkunçelebi & M. Gültepe* 112) a. Achene drawing. b. Fruiting capitula. c. Flowering capitula d. Phyllaries e. Achene.

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T. dshimilensis K.Koch by Çoşkunçelebi et al. (2017). Additional specimens of P.H. Davis (D. 44523 (E!)) and Trelawny (Trelawny 1003 (E!)) listed under the name of T. longirostris var. abbreviatus by Matthews (1975) in the Flora of Turkey were also identified in the present study as T. reticulatus Boiss. & Huet and T. pterocarpus DC, respectively.
by a thinner and sometimes curved beak as well (Table 2). Additionally, the achene beak is typically sulcate in *T. longirostris* var. *longirostris* and *T. abbreviatus* (Figure 1, Figure 6), and not sulcate in *T. porrifolius* subsp. *eriospermus* (Figure 5). More detailed morphological comparisons are given in Table 2.

According to Gültepe et al. (2015), the chromosome number of *T. abbreviatus* is 2n = 2x = 12 based on 4 different specimens. However, detailed morphological investigations of these specimens stored at KTUB revealed that none of them belong to *T. abbreviatus*. Pollen grains with oblate spheroidal shape were reported in *T. abbreviatus* by Gültepe et al. (2018) based on specimens collected from Muğla: Seki, Coşkunçelebi & M. Gültepe 345! (Appendix).

The present phylogenetic analysis is a preliminary study examining a large number of *Tragopogon* accessions from Turkey. The molecular phylogenetic analysis based on the ITS data set with multiple sampling supported the monophyly of the genus *Tragopogon* as indicated in recent molecular studies (Mavrodiev et al., 2004; 2005). ITS dataset also confirmed that the genus *Tragopogon* is

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### Table 2. Character comparison of *Tragopogon abbreviatus* with related species.

| Traits               | *T. abbreviatus* | *T. porrifolius* subsp. *longirostris* | *T. porrifolius* subsp. *eriospermus* | *T. dshimilensis* |
|----------------------|------------------|----------------------------------------|---------------------------------------|-------------------|
| **Habit**            | Biennial         | Biennial                               | Annual or biennial                     | Perennial         |
| **Stem**             | 24–92 cm, branched | 12–120 cm, branched                   | 24–76 cm, branched                     | 23–80             |
| **Peduncle**         | Thickened below capitula, involucre sparsely floccose or not at base | Thickened below capitula, involucre sparsely floccose or not at base | Thickened below capitula, involucre sparsely floccose or not at base | Not or slightly thickened, involucre floccose |
| **Leaves**           | Cauline leaves 3.5–33 × 0.25–1.0 cm, linear or linear to lanceolate with flat margin; basal leaves 3.5–35 × 0.20–0.5 cm, linear with flat margin | Cauline leaves 5–26 × 0.24–1.2 cm, linear or linear to lanceolate with flat margin; basal leaves 11–25 × 0.27–0.9 cm, linear with flat margin | Cauline leaves 4–17× 0.65–1.8 cm, linear or linear to lanceolate with flat margin; basal leaves 14–29 × 0.4–1.0 cm, linear with flat margin | Cauline leaves 5.0–8.5 × 0.5–2.5 cm, lanceolate/ovate, margin flat, basal leaves 14–30 × 0.35–1.0 cm, lanceolate, margin flat |
| **Phyllaries**       | 8, 20–35 × 1.8–4.0 mm in flower and 38–60 × 3.0–8 mm in fruit lanceolate, acute, longer than flowers | 5–8, 22–37 × 2.5–6.0 mm in flower and 42–95 × 4.5–15 mm in fruit lanceolate, acute, longer than flowers | 8–9, 20–32 × 2.3–5.5 mm in flower and 45–63 × 4.2–7.8 mm in fruit lanceolate, acute, longer than flowers | 7–11, 18–30 × 2.5–4.3 mm in flower and 14–40 × 2.7–6 mm in fruit, lanceolate, acute, equal to or shorter than flowers |
| **Ligules**          | 19–24 mm, purple | 8–16 mm, purple                        | 13–18 mm, purple                      | 17–25 mm, yellow  |
| **Achene**           | 19–35 mm, with five longitudinal rows of separate scales and five rows of shorter scales between | 29–54 mm, with ten longitudinal rows of short separate scales | 35–47 mm, with ten longitudinal rows of short separate scales | 17–25 mm, with 10 longitudinal rows of slightly unequal scales |
| **Beak**             | 9–19 mm long, equal to or longer than achene body and clavate at apex | 17–34 mm, sulcate, longer than achene body and clavate at apex | 14–27 mm, not sulcate, equal, shorter or longer than achene body and not clavate at apex | 5–13 mm long, equal or shorter than achene body and clavate at apex |
| **Annulus**          | Hairy            | Hairy                                  | Hairy                                 | Hairy             |
| **Pappus**           | 20–30 mm, pale greyish-brown or straw coloured | 23–35 mm, pale greyish-brown or straw coloured | 25–35 mm, pale greyish-brown or straw coloured | Pappus 15–25 mm long, fawn-coloured |
| **Achene type according to Sukhorukov & Nilova (2015)** | Group V, but shorter achene length | Group V | Group V, but beak not angled | Group VII and Group VIII |
distinct from the closely related genus Gerepogon L. and other members of Subtribe Scorzonerae as stated by Mavrodiev et al. (2004). As seen in Figure 4, 4 subgroups appeared in the phylogenetic tree. All sub-groups consist of yellow and/or purple-flowered species. Similarly, both (all) sub-groups are not discriminated on features of peduncles below the capitula (all sub-groups consist of swollen peduncles). According to the phylogenetic tree, 5 accessions belonging to the T. abbreviatus are clustered with strong support (PP = 1.00, JK = 93). Thus, present phylogenetic tree inferred from the dataset of our own and GenBank support the status of T. abbreviatus as a distinct species, and also distinguish T. longirostris var. longirostris from T. porrifolius as previously suggested by Greuter (2003). Gültepe et al. (2016) also made similar taxonomical comment about T. longirostris var. longirostris. As seen in molecular phylogenetic tree (Fig. 4), T. longirostris and T. coelesyriacus (Boissier, 1849) are sister taxa so 2 of them should be treated under the name of T. coelesyriacus takes priority over that the names of T. longirostris (Feinbrun-Dothan, 1978; Dimopoulos et al., 2016). Besides, morphological examination of the holotype of T. coelesyriacus stored at G-Boiss (G00330023 photo!) shows that it belongs to T. longirostris as stated by Boissier (1875). However, T. coelesyriacus clade consists of 2 recently accepted taxa T. porrifolius subsp. australis, T. porrifolius subsp. longirostris and T. krascheninnikovii (Nikitin, 1933) proposed as a synonym to T. longirostris by Rechinger (1977). It looks that the T. coelesyriacus clade is a monophyletic complex including several unresolved taxa so further studies need to solve the infraspecific taxonomy of this clade (Fig. 4).

Additionally, as seen in the phylogenetic tree (Figure 4), some representatives of T. porrifolius were aggregated into Subgroup I and rest of accessions are appeared in polytomy. This situation coincides with the view of Mavrodiev et al. (2007), who indicated that T. porrifolius is a polyphyletic complex based on combined ITS and ETS datasets. Present findings also supplied additional molecular evidence for T. dshimilensis, previously accepted as a synonym of T. abbreviatus by Boissier (1875). As seen in Figure 4, T. dshimilensis is located in the Subgroup II with strong support (PP = 1.00, JK = 61) rather than T. abbreviatus. In conclusion, the present study has shown that T. abbreviatus, T. porrifolius subsp. longirostris and T. coelesyriacus are not the members of T. porrifolius complex contrary to what stated in Greuter (2003). Besides, this complex includes in Turkey only T. porrifolius subsp. eriospermus contrary to what reported by Coşkunçelebi and Gültepe (2012).

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Appendix. Examined specimens in the present study.

Tragopogon abbreviatus: A1 Edirne: Keşan, 5 km south-east of Bahçeköy, 165 m, 20 May 2012, Coşkunçelebi & M. Gültepe 337 (KTUB), 40°44'N, 026°40'E; A1 Çanakkale: Gelibolu, above Yağova Village, near graveyard, 71 m, 02 Jun 2011, Coşkunçelebi & M. Gültepe 184 (KTUB), 40°15'N, 026°24'E; A1 Çanakkale: Gelibolu, above Yağova Village, 110 m, 18 May 2013, Coşkunçelebi & M. Gültepe 338 (KTUB), 40°16'N, 026°24'E; Between Gelibolu and Keşan, Koru Mountain, 246 m, 18 May 2013, Coşkunçelebi & M. Gültepe 441 (KTUB), 40°42'N, 026°47'E; A1 Tekirdağ: Between Sofukuğ & Şarköy, 222 m, 03 Jun 2011, Coşkunçelebi & M. Gültepe 188 (KTUB), N40°38'N, 027°00'E; Between Barbaros and Kumbağ, Mürrefe road, 361 m, 29 Jun 2011, Makbul 302 & Coşkunçelebi (KTUB) 40°50'N, 027°25'E; A2 Bursa: Gürsu, between Narlıdere and Marmara Island, 0–10 m, 11 May 1978, E. Alpınar 71778 (ISTE); B1 İzmir: Bergama, 400 m, 17 May 2013, 40°18'N, 029°40'E, Coşkunçelebi & M. Gültepe 325 (KTUB); A2 İstanbul: Beykoz, Kartepe, 223 m, 16 May 2012, 41°07'N, 027°09'E, Coşkunçelebi & M. Gültepe 367 (KTUB); A3 Bilecik: nr Bilecik in Karasu valley, 300-400 m, Bornm. 14359; A4 Ankara: Kızılcahamam, Soğuksu National Park, Çakmakli, Doruk Tepe location, stony places, 1663 m, 0. Eyüboğlu 1663 (GAZI); A4 Kırıkkale: Between Kırıkkale and Ankara, Elmadağ, Gürevik valley, 968 m, 07 Jun 2010, N39°56', 033°16'E, Coşkunçelebi & M. Gültepe 122 (KTUB); A5 Çorum: Karga, between Hachamz-Abdullah plateau, 600 m, 16 May 1975, M. Kilinç 2079 (ANK); A5 Amasya: Taşıova, between Üluköy and Alpşaran, 395 m, 11 May 2012, 40°47'N, 036°20'E, Coşkunçelebi & M. Gültepe 320 (KTUB); Manisa: SpilDağı, place of At Alani, roadsides, 1000 m, 22 May 2011, 38°35'N, 027°25'E, Coşkunçelebi & M. Gültepe 168 (KTUB); A8 Gümüşhan: Gümüşhan, 3 km south of Bayburt, 1620 m, 21 June 1968, F. Meyer, G. Oğuz (EGE); B1 İzmir: Çamaltı saltern, Çılabzak mound, rocky places, 15 May 1994, N. Keypicci 89 (EGE); Bornova, Çimentaş, roadside, 15 May 1966, H. Peşmen 1044 (EGE); between Çeşme and Ilica, 8 May 1966, İ. Regel (EGE); B2 Uşak: Between Uşak and Gediz, roadsides, under Pirus sp. forest 698 m, 12 Jul 2012, 38°50'N, 029°16'E, Coşkunçelebi & M. Gültepe 385a (KTUB); B3 Eskişehir: Sündiken mountain, Kalomlak stream, 1400–1600 m, 12 June 1971, T. Ekim 25 (ANK); Sündiken Mountain, Karaöz stream, 1100 m, 23 May 1971 T. Ekim 25 (ANK); B3 Afyon: Boyat, east slopes of Asan Tepe, 1340 m, 29 June 1975, M. Vural 263 (ANK); B3 Isparta: Eğridir, 940 m, 20 May 1966, İ. Regel (EGE); B4 Antalya: Between Antalya and Tereki, volcanic tuff, roadside, under trees, 1250 m, 21 May 1989, N. Adığüzeli (GAZI); B6 Kahramanmaraş: Göksun, Ericek, volcanic tuff, roadside, under trees, 1250 m, 21 May 1989, N. Adığüzeli (GAZI); B7 Erzincan: Kemaliye, between Sıra Konak and Sari
Çiçek Mountain, 1738, 15 Jun 2011, 39°12' N, 038°28'E, Çoşkunçelebi & M. Gültepe 214 (KTUB); B7 Elazığ: Haroğlu village, stony places, north slope, 1400 m, 7 July 1980, H. Eyvén 398 (ANK); B9 Van: Between Gevaş and İskirt Village, roadsides, 1677 m, 09 Jun 2011, 38°18'N, 043°06'E, Çoşkunçelebi & M. Gültepe 210 (KTUB); B9 Bitlis: Around Tanrıyar village, forest clearance, 1600, 04 May 2003, AA 2962 (VANF); C1 Aydın: Söke, ruins of Priene, 19 June 1971, I. Akbaş 25343 (ISTF); C1/C2 Muş: Road of Marmaris to Ağğan, roadsides, 10 m, 21 May 2011, Çoşkunçelebi & M. Gültepe 166 (KTUB); C2 Aydın: Çine, Mandıra Hill, 1650 m, 11 July 1992, Melahat Evcin 10059 (KATO); C2 Denizli: Babadağ, between Sarayköy and Acıdere, roadside, 1100 m, 08 May 1996, S. Ölük, Ö. Seçmen, Y. Gemici (EGE); C3 Burdur: Between Burdur and Çeltikçi, 1204 m, 26 May 2010, 37°37'N, 030°22'E, 493, Çoşkunçelebi & M. Gültepe 112 (KTUB); C3 Konya: Ereğli, Aydos mountain, protected area of Ayrançı Damp, steppe, limestone bedrock, 1300 m, 19 May 1973, S. Erık 979 (HUB); C3 Konya: Kocabey, Sulanak area, 1616 m, 10.07.2008, 41º14'25"E, 39º12'35"N, Çoşkunçelebi & M. Gültepe 359 (KTUB); İzmir: Kuşadası, Kuşadası mountain, 850 m, 12.07.1974, İ. Akbaş 25030 (ISTF); C4 İçel: Anamur, between Anamur and Kazancı, 1204 m, 15 April 1991, T. Ekim 9355 (Gazi); C5 Konya: Ereğli, Aydos mountain, protected area of Ayrançı Damp, steppe, limestone bedrock, 1300 m, 19 May 1973, S. Erık 979 (HUB); C5 Konya: Kocabey, Sulanak area, 1616 m, 10.07.2008, 41º14'25"E, 39º12'35"N, Çoşkunçelebi & M. Gültepe 359 (KTUB); C5 Konya: Ereğli, Aydos mountain, protected area of Ayrançı Damp, steppe, limestone bedrock, 1300 m, 19 May 1973, S. Erık 979 (HUB); C5 Konya: Kocabey, Sulanak area, 1616 m, 10.07.2008, 41º14'25"E, 39º12'35"N, Çoşkunçelebi & M. Gültepe 359 (KTUB); C6 Hatay: Road of Antakya to İskenderun, road separation of Kırıklar, 5 km to İskenderun, 385 m, 16 May 2010, 36°28' N, 036°17' E, Çoşkunçelebi & M. Gültepe 90 (KTUB); C7 Hatay: Italian road to İskenderun, road separation of Kırıklar, 5 km to İskenderun, 385 m, 16 May 2010, 36°28'N, 036°17'E, Çoşkunçelebi & M. Gültepe 90 (KTUB); C7 Hatay: Italian road to İskenderun, road separation of Kırıklar, 5 km to İskenderun, 385 m, 16 May 2010, 36°28'N, 036°17'E, Çoşkunçelebi & M. Gültepe 90 (KTUB); C9 Siirt: between Şirvan and Pervari, 28 km to Pervari, ocher area, calcareous rocky land, 1350-1400 m, 14 June 1980, A. Güner 2424- M. Koyuncu (HUB); Syrian Arab Republic: Syria, 22.5.1841, Kotschy, K. G. T. 245a (G0033026 photo); Lebanon: Liban, Apr.-May 1846, Boissier, A. s.n., (G00330023 photo); Egypt: Egypt, 06.1832, Bové, N. 115 (G00473996 photo)

Tragopogon dshimilensis: A4 Kastamonu: N side of Ilgaz Da., 1700 m, Davis & O. Polunin, D. 25073 (E); Ilgaz Mountains, 1600 m, 18.09.1981, Y. Akman, E. Yurdakulol & M. Demiriz (ANK); A7 Trabzon: Maçka, Zığana, Old Gümüşhane road, under Pinus sylvestris forest, 1870 m, 26.05.2012, 40° 38' N, 039° 23' E, Çoşkunçelebi & M. Gültepe 355 (KTUB); Between Trabzon and Gümüşhane, entrance of Zigana tunnel from Gümüşhane side, under the forest near roads, 11.07.2013, 40° 38' 16" N, 039° 22' 57" E, Çoşkunçelebi & M. Gültepe 450 (KTUB); A7 Gümüşhane: Kürtün, between Söğütlü and Kazıklı, pastures, 1965 m, 30.06.2010, 40° 53' N, 039° 00' E, Çoşkunçelebi & M. Gültepe 137 (KTUB); Kürtün, Sari Baba village, 1775 m, 04.08.2011, 40° 03' 13" N, 039° 01' 32" E, Çoşkunçelebi & M. Gültepe 297 (KTUB); A8 Trabzon: Uzungöl, Demirkapı, alpine, 2100 m, 25.07.2009, Çoşkunçelebi & M. Gültepe 82 (KTUB); A8 Rize: İkizdere, Cimil, Ortaköy, road sides, 1900 m, 23.07.2009, 40° 45' N, 040° 45' E, Çoşkunçelebi & M. Gültepe 81 (KTUB); Cimil, 1848 m, 28.07.2011, 40° 44' N, 040° 44' E, Çoşkunçelebi & M. Gültepe 301 (KTUB); İkizdere, Anzer, between down and up Anzer, 1828 m, 28.07.2011, 40° 37' N, 040° 31' E, Çoşkunçelebi & M. Gültepe 302 (KTUB); İkizdere, Anzer, 1715 m 19.06.2012, 40° 37' N, 040° 32' E, Çoşkunçelebi & M. Gültepe 359 (KTUB); Camlihemşin, between Hisarcık Köy and Sırakoğlu, alpine zone; 1600–2000 m, A. Güner 4013 (ANK); İkizdere, Ballıköy (Anzer), meadows, 2150 m, 19.07.1984, M. Vural 3079 (ANK); İkizdere, Ballıköy, 1950 m, 27.07.1991, A. Güner, T. Ekim, M. Koyuncu & H. Karaca (ANK); İkizdere, Cimil, Yetimhoca Village, roadsides, 1850 m, 24.08.1985, A. Güner & M. Vural (AG 6932) (ANK); İkizdere, Cimil, Cermi ve Merkez plateau, 2800 m, 23.07.1984 A. Güner 6029 (ANK) A9 Artvin: Şavşat, Yavuz Village, pastures, 1449 m, 10.07.2008, 41°13' N, 42°23' E, Çoşkunçelebi & M. Gültepe 35 (KTUB); Şavşat, Kocabey, Sultan area, 1616 m, 10.07.2008, 41°14' N, 42°25' E, Çoşkunçelebi & M. Gültepe 37 (KTUB); Şavşat, Meşeli village, 1591 m, 18.07.2012, 41°18' N, 042°28' E, Çoşkunçelebi & M. Gültepe 417 (KTUB); A9 Karş: Susuz, 8 km from Kars, fallow field, 05.07.1957 Davis & Hedge (D.30585) (ANK); Kars: Sarıkamış, 2100 m, 07.07.1997, Davis & Hedge (D.30779) (ANK); Ziyaret Dağı, above Yalnızçam, igneous rocky slopes, 29.06.1957, Davis & Hedge (D.30324) (ANK); Yalnızçam, very stony volcanic slopes, 1900 m, 16.06.1957, Davis & Hedge (D.29615) (ANK).