

Revision of the Section *Hololeuce* Bunge of the Genus *Astragalus* L. (*Leguminosae*) in Turkey

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Abstract: We revised the section *Hololeuce* Bunge of the genus *Astragalus* L. (*Leguminosae*) in Turkey. The section used to contain 20 taxa in Turkey, but in this study it has been reduced to 15. A new species (*Astragalus dumanii* Ekici & Aytaç) has been described. In addition, we concluded that *A. vuralii* H.Duman & Aytaç, *A. cylindraceus* DC., *A. alindanus* Boiss., *A. paecilanthus* Boiss. & Heldr. and *A. squalidus* Boiss. & Noë are synonyms of *A. andrasovszkyi* Bornm., *A. globosus* Vahl, *A. hirsutus* Vahl, *A. sibthorpianus* Boiss. and *A. amoenus* Fenzl respectively. The pollen grains are tricolporate, prolate, subprolate or prolate sphaeroidal and the ornamentation is reticulate.

Key Words: Turkey, Revision, *Astragalus*, sect. *Hololeuce*

Türkiye'nin *Astragalus* L. (*Leguminosae*) Cinsinin *Hololeuce* Bunge Seksiyonunun Revizyonu

Özet: Türkiye'nin *Astragalus* L. cinsine ait *Hololeuce* Bunge seksiyonunun revizyonu yapılmıştır. Seksiyon ülkemizde 20 taksona sahip iken yapılan bu çalışmayla sayı 15'e indirilmiştir. Bilim dünyası için yeni bir tür (*Astragalus dumanii* Ekici & Aytaç) betimlenmiştir. Ayrıca *A. vuralii* H.Duman & Aytaç, *A. andrasovszkyi* Bornm.'nin; *A. cylindraceus* DC. *A. globosus* Vahl'un; *A. alindanus* Boiss. *A. hirsutus* Vahl'un; *A. paecilanthus* Boiss. & Heldr. *A. sibthorpianus* Boiss.'un; *A. squalidus* Boiss. & Noë *A. amoenus* Fenzl'un sinonimleri oldukları tespit edilmiştir. Polenler trikolporat, prolat, subprolat veya prolat sferoid ve ornemantasyonu retikulattır.

Anahtar Sözcükler: Türkiye, Revizyon, *Astragalus* Sek. *Hololeuce*

Introduction

During the preparation of the Flora of Turkey, many taxonomical problems in some genera and sections were only mentioned but not solved because of the limited time and material. The editors suggested that further revision should be carried out to solve these problems (Chamberlain & Matthews, 1970; Davis & Hedge, 1975; Davis, 1975). *Astragalus* L., the richest genus that belongs to the family *Leguminosae*, is an example with many unresolved taxonomical problems. Thus, certain sections of the genus *Astragalus* have been revised since the publication of volume 3 of the Flora of Turkey such as *Acanthophaea* Bunge and *Aegacantha* Bunge (Deml, 1971), *Stipetella* G.Grig. (Podlech,

1975), *Caraganella* Bunge (Podlech, 1975), *Theiochrus* Bunge (Podlech & Kozik, 1983), *Herpocaulos* Bunge (Podlech, 1984), *Caprini* DC. (Podlech, 1988), *Hypoglottidei* DC. (Maassoumi, 1988), *Campylanthus* Bunge, *Microphysa* Bunge and *Poterion* Bunge (Tietz, 1988), *Platyglottis* Bunge (Podlech, 1990), *Chlorostachys* Bunge, *Phyllobium* Bunge and *Skythropus* Simpson (Weninger, 1991), *Megalocystis* Bunge (Tietz & Zarre, 1994), *Hymenostegis* Bunge (Zarre & Podlech, 1996), *Dasyphyllium* Bunge (Aytaç, 1997), *Adiaspastus* Bunge, *Macrophyllium* Bunge and *Pterophorus* Bunge (personal communication with Zarre), and *Alopecias* Bunge (personal communication with Akan).

The first study on the genus was carried out by Pallas (1800), followed by those of De Candolle (1802) and Bunge (1868, 1869). The origins of the genus extend to the 1700s and a short taxonomic history of the genus is given on the in Figure 1.

Tournefort collected some thorny species of *Astragalus* from the Middle East that he named *Tragacantha*. Later, as seen in Figure 1, several scientists have studied the genus. In 1983, the German botanist Podlech decided to separate some species of this genus as a new genus *Astracantha*, delimited by having “*paripinnate leaves with spiny rachis and flowers borne in axis of leaves*” (Podlech, 1983). Nevertheless, after this separation, it was realised that there are many transitional species between these 2 genera. That they were reunited again as the generic delimitation of these 2 genera is not justified (Zarre & Podlech, 1997).

Astragalus is represented by c. 10 subgenera, 130 sections and 2500 taxa world wide. A comparison of the number of species in Turkey and other countries is given in Table 1 Shishkin (1965); Chater (1968); Chamberlain & Matthews (1970); Tackhom, (1974); Townsend & Guest (1974); Hedge & Podlech (1987); Zohary (1987);

Podlech (1988; 1999; 2001); Davis et al. (1988); Greuter et al. (1989); Maassoumi, (1989; 1994; 1998); Yakovlev et al. (1996); Aytaç, (2000).

As it is impossible to study all the species at the same time, it is more reasonable to study the genus section by section.

The members of the *Hololeuce* section are distributed across the central and eastern parts of Anatolia, the Mediterranean and Black Sea regions in Turkey, Afghanistan, Armenia, Azerbaijan, Georgia, Iraq, Iran, Lebanon, Tajikistan and Turkmenistan. The world distribution of the section *Hololeuce* is shown in Figure 2.

The Flora of Turkey, Volume 3 (Chamberlain & Matthews, 1970), recognised 20 species within the boundaries of Turkey, 16 of which were considered endemic. Some of the species are only known from ancient gatherings such as *A. sibthorpianus* (1850), *A. andrasovszkyi* (1911) and *A. caudiculosus* (1916). In some species, some important morphological characters are missing. For example, in *Astragalus caudiculosus*, the fruit character was not known. In addition, there is a similarity between the sections *Hololeuce* and *Onobrychium*. Some of the species of *Onobrychium* are

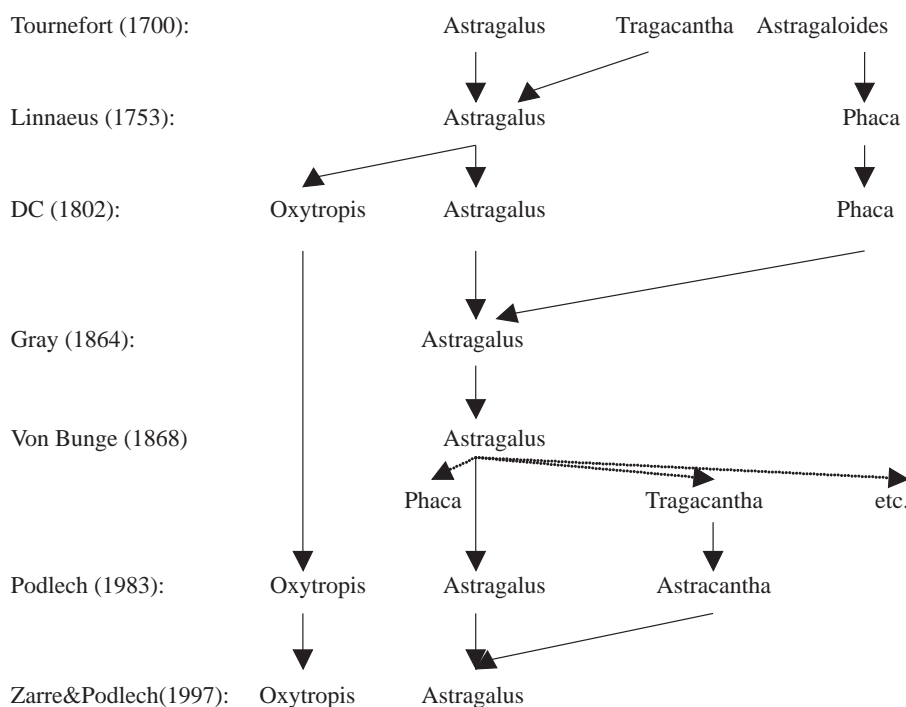
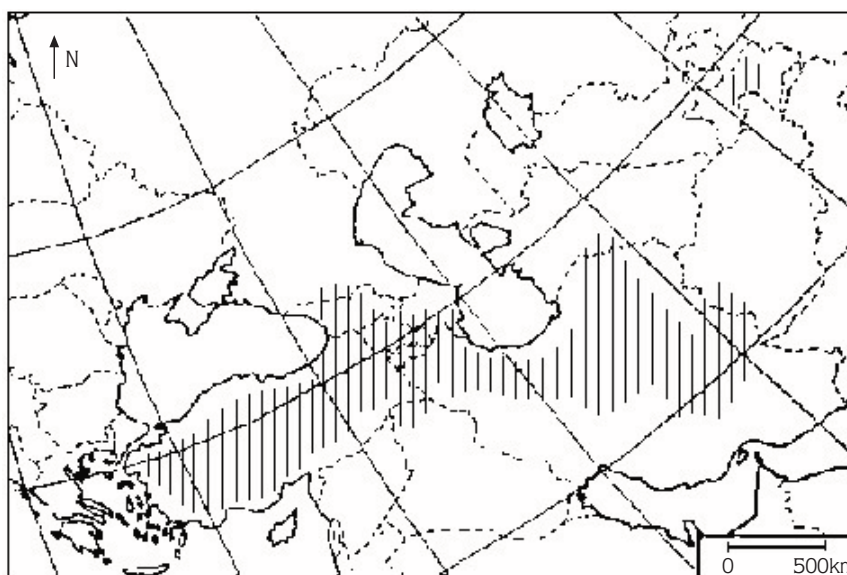


Figure 1. The short taxonomic history of *Astragalus*.

Table 1. Comparison of the number of *Astragalus* species between Turkey and other old world countries.

Region	Country	Total Species	End. Species	End. rate
W. ASIA	Iran	678	381	56.19%
	Saudi Arabia	21	1	4.76%
	Iraq	145	9	6.20%
	Afghanistan	293	144	49.14%
Former USSR	Russia	1005	562	55.92%
Europe	Europe	142	50	35.21%
	Turkey	446	210	47.08%
M. EAST	Syria-Lebanon	59	15	25.42%
	Jordan	35	2	5.71%
	Palestine	52	4	7.69%
S. ASIA	India	54	4	7.40%
	Pakistan	135	26	19.25%
E. ASIA	China	278	22	7.91%
AFRICA	Egypt	34	2	5.88%
	Algeria	39	2	5.12%
	Morocco	45	9	20.00%
	Libya	89	24	26.96%

Figure 2. World distribution of the section *Hololeuce*.

transferred to *Hololeuce*, whereas some species of *Hololeuce* are transferred to *Onobrychium*. Therefore, it was decided to carry out the revision of section *Hololeuce* presented here; the revision of the section *Onobrychium* is also planned.

Materials and Methods

Research materials of the section *Hololeuce* were collected from different parts of Turkey in April-August, both in the flowering and fruiting period, between 1996 and 1999. In order to study the variation patterns, specimens were collected from as many different parts of the existing distribution area of the section as was possible. In addition, the collections of AEF, ANK, ATA, B, CUM, E, EGE, GAZI, HUB, ISTF, K, KNYA, M, MSB and W herbaria were examined. The author name of every species was written according to the Authors of Plant Names (Brummitt & Powell, 2001).

Morphological Studies

A range of characteristics that were considered to be taxonomically important in the section was investigated. These include the following: stipule structure and length, leaf length, leaflet shape and length, the inflorescence, bract shape and length, whether the calyx is inflated or not, the corolla standard, wing and keel and the structure, and size of the fruit beak. Measurements were obtained from at least 10 replicates on each of 10 specimens and the average value of each character was evaluated. The maximum and minimum values of the measurements of these parts are given in the descriptions of the taxa.

Palynological analysis

The pollen morphology of the species was examined using a Kyowa Micro-Lux-11 light microscope (10 x 100) and pollen preparations were made by the Woodhouse method and stained with basic fuchsin (Woodhouse, 1959). Their descriptions have been drawn up using the morphological characters given below (Pehlivan, 1995):

- Pollen type: The aperture shape and arrangement on the pollen.
- Pollen shape: The division of the polar axis (P) to the equatorial axis (E).
- The exine and intine thickness.
- The polar and equatorial diameter of the colpus: Clg

and Clt were measured and the ratio of Clg/Clt calculated.

- Structure: In the optic cross-section, the characters of a layer of pollen.
- Sculpture: In the optic cross-section, the surface of exine and its ornamentation.
- The length of pores on the polar side (Plg) and equatorial length were determined.

In addition, the details of the pollen and morphology were examined using a scanning electron microscope (SEM). The sizes of the pollen of all species are given in Table 2.

SEM Method

Pollen grains were transferred to stubs and coated with gold. After studying the resulting photographs, we could not find diagnostic differences.

Taxonomic treatment of the section:

Astragalus sect. *Hololeuce* Bunge in Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 104. 1868.

Lectotype: *A. hololeucus* Boiss. & Buhse (Podlech, 1990).

= *A. sect. Chlorosphaerus* Bunge in Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 106. 1868.

Lectotype: *A. chlorosphaerus* Boiss. (Podlech, 1990).

Scapose or shortly caulescent, perennial herbs. Stipules free or adnate to the petioles. Leaves imparipinnate; leaflets 4-20-paired, with bifurcate or sub-bifurcate hairs; narrowly ovate or narrowly elliptic, oblong or obovate. Inflorescence a dense, pedunculate many-flowered spike; globose, ovate or cylindrical. Peduncle generally white-hairy and almost as long as or longer than leaves. Bracts linear, triangular-ovate, with white or black hairs. Bracteoles absent or 1-2. Pedicels generally absent or up to 1 mm. Calyx membranous, generally tubular, hairy; calyx teeth linear, triangular; generally with black hairs outside, glabrous or with only white hairs inside. Standard glabrous. Claw of wings and keel only adnate at the base to staminal tube. Stamens diadelphus, filaments glabrous. Staminal tube straightly cut. Ovary ovate or elliptic, with white hairs. Fruits ovoid, oblong; bilocular, almost as long as calyx, beak straight or curved; 2 seeds in each locule, Seeds rectangular-reniform, light brown or brown, smooth.

The average polar axis of the pollen grains is 21.42–32.93 μm , the equatorial axis is 17.13–28.26 μm . The pollen grains are tricolporate, prolate, subprolate or prolate sphaeroidal and with a reticulate ornamentation. Exine tectate, 1.08–1.30 μm thick; intine 0.50–1.68 μm thick.

Before the Flora of Turkey, *Chlorosphaerus* and *Hololeuce* were maintained as distinct sections in *Astragalus*. The only cited difference between these sections is that the stipule is adnate to the petioles in *Chlorosphaerus*, whereas it is free in *Hololeuce*. As this feature only is not good enough for section separation, during preparation of the account of *Astragalus* for the Flora of Turkey, the authors decided that *Chlorosphaerus* should be combined with *Hololeuce* (Chamberlain & Matthews, 1970).

Key to the Turkish species of the section

1. Stipules free from the petiole
 2. Leaflets with sub-bifurcate hairs 1. *A. incertus*
 2. Leaflets with bifurcate hairs Leaflets sparsely hairy to glabrous on upper side, standard 22-28 mm 2. *A. hyalolepis*
 3. Leaflets sparsely hair to glabrous on upper side, standard 22-28 mm
 3. Leaflets loosely to densely hairy on upper side; standard at most 22 mm
 4. Calyx teeth as long as tube
 5. Calyx 10-14 mm, the teeth 5-7 mm; legume 14-16 mm 7. *A. cataonicus*
 5. Calyx 6-10 mm, the teeth 3-5 mm; legume 8-11 mm 3. *A. bicolor*
 4. Calyx teeth distinctly shorter than the tube
 6. Peduncle 0.5-1.5 cm; legume 13-15 mm 8. *A. dumanii*
 6. Peduncle 2-13 cm; legume 5-10 mm
 7. Stipules and bracts hairy; standard 18-21 mm 5. *A. andrasovszkyi*
 7. Stipules and bracts ciliate; standard 9-18 mm
 8. Inflorescence 10-30-flowered; standard 9-12 mm, whitish yellow or lilac 6. *A. alyssoides*
 8. Inflorescence 5-10-flowered; standard 12-18 mm, purple 4. *A. caudiculosus*
 1. Stipules adnate to the petiole
 9. Standard 9-14 x 2-3 mm, rounded at base, slightly constricted at the middle
 10. Plant 5-14 cm long; peduncle 2.5-10 cm, with long spreading and short adpressed hairs; calyx 7-10 mm, teeth 4-5 mm ... 12. *A. stenosemius*
 10. Plant 2-4 (-5) cm long; peduncle 1-3 cm, with spreading hairs; calyx 6-7 mm, teeth 3-4 mm 13. *A. stenosemioides*
 9. Standard 12-20 x 3-9 mm, widest at the middle, gradually narrowed to the base
 11. Rachis with adpressed hairs; bracts 2-4 mm 14. *A. amoenus*
 11. Rachis at least partly with spreading hairs; bracts 5-10 mm
 12. Leaflets on upper side glabrous to sparsely hairy; standard 12-18(-20) x 3-5 mm; legumes covered with adpressed hairs..... 11. *A. sibthorpianus*
 12. Leaflets on upper side loosely to densely hairy; standard 15-20 x 6-9 mm; legumes covered with long spreading hairs
 13. Peduncle 1-5 cm, with long spreading hairs and short adpressed black hairs; bracts flat; calyx teeth 2-3 mm 9. *A. hirsutus*
 13. Peduncle 5-24 cm, with only long spreading hairs, soon sparsely hairy or glabrous; bracts keeled; calyx teeth 3-5 mm..... 10. *A. globosus*
1. *Astragalus incertus* Ledeb., Fl. Ross. 1: 647. 1843.
Holotype: [Turkey] mt. Ararat, *Hehn* (LE).
 = *A. incertus* var. *bicolor* Trautv., Trudy Imp. S.-Petersburgsk. Bot. Sada 2: 523. 1883.
Syntypes: Armenia, in montibus Ararat majore, ad lacum Küpgöl, *G.F.R.J. von Radde*; in monte Ararat minore, *G.F.R.J. von Radde*; in Turcia prov. Kars, in monte Aschich-dade, *G.F.R.J. von Radde*.
 = *A. incertus* var. *unicolor* Trautv., Trudy Imp. S.-Petersburgsk. Bot. Sada 2: 523. 1883.
Type: Armenia in monte Alagös, *G.F.R.J. von Radde*.

= *A. incertus* var. *sparsevillosus* Ponert, Feddes Repert. 83: 630. 1973.

Type: [Turkey] Çoruh Tiryal a. above Murgul, 2300 m, *P.H. Davis 29940b* (E!).

= *A. araraticus* Azn., Magyar Bot. Lapok 17: 8. 1918.

Syntypes: [Turkey] Grand Ararat, 2700-3000 m, *G.V. Aznavour 2089, 2135*.

= *A. oxytropoides* Bunge, Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci.-Math., Seconde Pt. Sci. Nat. 7: 585. 1859.

Type: Caldera des Alagez, *H.W. Abich*.

= *A. lasioglottis* M.Bieb. var. *subacaulis* C.A.Mey., Verz. Pfl. Caucasus: 140. 1831.

Type: Apricus Caucasi Cabardinici ad rivum Podkumek circa acidalum Nartsana, 1809, *Steven* (LE; iso: LE, KI).

Figure 3,4.

Plants 4-17 cm, covered with sub-bifurcate and unequally bifurcate hairs. Caudex branched, with short to elongated stolons. Stem absent or up to 1.5 cm, erect, sulcate, covered with adpressed white hairs, concealed by the overlapping stipules. Stipules membranous, whitish-yellow, 6-8(-12) mm, narrowly triangular to triangular, free from the petiole, dense-rarely sparse with adpressed white hairs, or with also a few black hairs. Leaves 2-10 cm; petiole 0.5-4 cm covered with sub-adpressed, sub-bifurcate white hairs. Leaflets 10-18(-20)-paired, flat or somewhat folded, narrowly elliptic to elliptic or ovate, acute or minutely mucronulate at the apex, 2-9 x 1.3-3.5 mm, covered upper surface with loose to rather dense ± spreading hairs, lower surface with more dense adpressed hairs. Peduncle 1.5-14 cm, sulcate, densely covered with adpressed, sub-bifurcate white hairs and with short bifurcate black hairs. Raceme globose, ovoid or shortly oblong, 10-15-flowered, 1-1.5 x 1.3 cm. Bracts membranous, greenish-yellow or green, narrowly triangular, 4-10 mm, densely covered with spreading sub-bifurcate white hairs and with some adpressed, short black hairs. Bracteoles absent. Pedicels c. 1 mm, hairy. Calyx greenish-yellow, tubular, 5-8 mm, sparsely to densely covered with long sub-bifurcate white and with shorter bifurcate black hairs; teeth subulate, green, 2-3 mm, with dense predominantly black hairs, on innerside only in upper part with white hairs or sometimes also with few black hairs. Corolla violet, purplish-red or lilac.

Standard 12-18 x 5-7 mm, oblong to elliptic, retuse to emarginate at the apex, without clearly differentiated claw, gradually narrowed to the base. Wings 10-14 mm, blades (limb) narrowly oblong, clearly constricted above the auricle, obtuse at the apex, 5-8 x 1.5-2 mm, auricle c. 1 mm, claw 5-7 mm. Keel 8-11 mm, blades obliquely oblong, obtuse to acute at the apex, 4-6 x 2.5-3.5 mm, auricle 0.2-0.3 mm, claw 4-5 mm. Stamens 8-11 mm, the upper 2-3 mm free. Ovary shortly stipitate, white hairy; style hairy only at the base. Fruits narrowly ovate, 8-13 x 3.5 mm, dorsiventrally compressed, densely covered with spreading, long sub-bifurcate hairs; beak 1-2 mm, straight. Seeds 2-3 mm, light brown, smooth.

Flowering time: 7-8. **Habitat:** Steppe, screes and rocky slopes, 2300-3400 m.

Specimens seen:

Turkey: [A8] Bayburt: Kara Kaya mt., N. of Baiburt, 3050 m, 24.7.1934, *Balls 1785A* (E, K) - Erzurum: Dumluca, c. 30 km Luftlinie N Erzurum, 2500-2800 m, 14.8.1982, *Sorger & Buchner 82-123-41* (W) - Kargapazarı pass between Şenyurt and Başören (NE Erzurum), 3000 m, 7.1996, *Rasmout 125* (MSB) - Tortum mt., Kabaktepe village, 2670-2850 m, steppe, 9.7.1977, *A. Tatlı 5633* (ATA, KNYA) - Rize: Passhöhe zwischen İkizdere und İspir, 2600-2900 m, 10.8.1982, *Sorger & Buchner 82-119-72* (W) - Soğanlı pass, 3050 m, 18.8.1962, *Furse 4071* (K) - ibid., 2700-2800 m, 8.8.1997, *M. Ekici 2056 & H. Akan* (GAZI, MSB) - Çamlıhemşin, Yukarı Kavrun plateau, 2750-3010 m, 9.8.1980, *A. Güner 2878* (ANK) - Köprübaşı, Kemer pass, 2450 m, 25.7.1991, steppe, *A. Güner 9665 et al.* (GAZI) - [A9] Kars: Killik mt., W of Akçay - Cumaçay road, 2400 m, 15.7.1967, *Watson et al. 3411* (E, K) - Posof, 2300-2500 m, 3.8.1985, *N. Demirkuş 3225* (HUB) - [B8] Bingöl: Bingoell (inter Musch u. Erzurum), 7800', 23.8.1859, *Kotschy 810* (W) - Erzurum: Palandöken mt., 2700 m, 1.7.1997, *M. Ekici 2014 & H. Akan* (GAZI, MSB) - [B9] Pantuki, 10.260 ft., 19.8.1933, *Balls 569* (E) - zwischen Ağrı und Hasiran, W Eleşkirt, Weg nach Hayrangöl, 2700 m, 17.8.1987, *Engel 141* (B) - [B10] Ağrı: Ararat (Ağrı mt.), S-Seite, 3000 m, 31.7.1966, *H.M. Steiner* (W) - Hama mt., Doğubeyazıt, 2900-3000 m, 3.8.1956, *Baytop* (E) Kars: Aralık, Büyük Ağrı mt., Serdarbulak plateau, 2400-2700 m, 6.7.1984, *M. Koyuncu 7006*, (AEF).

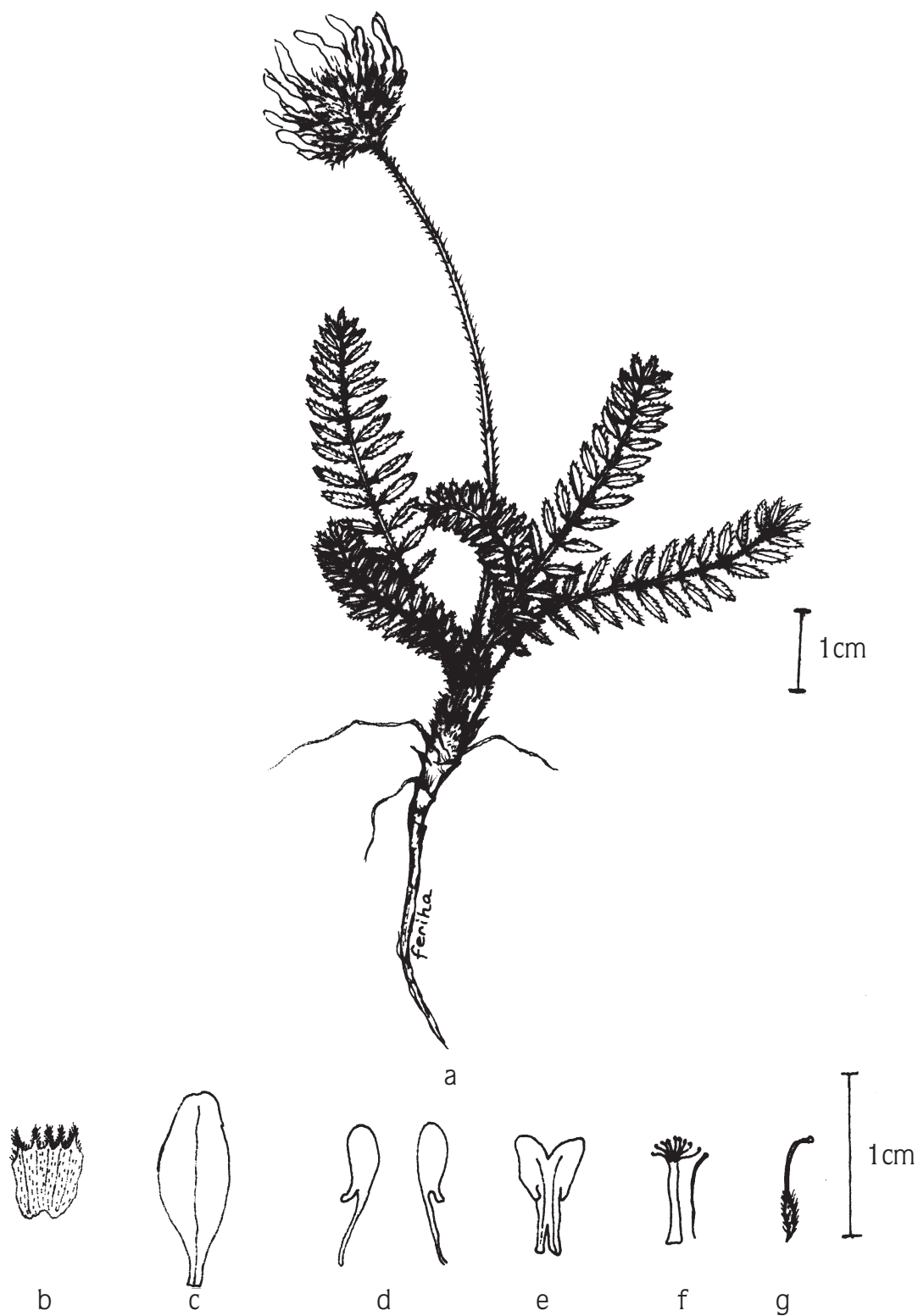


Figure 3. *A. incertus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

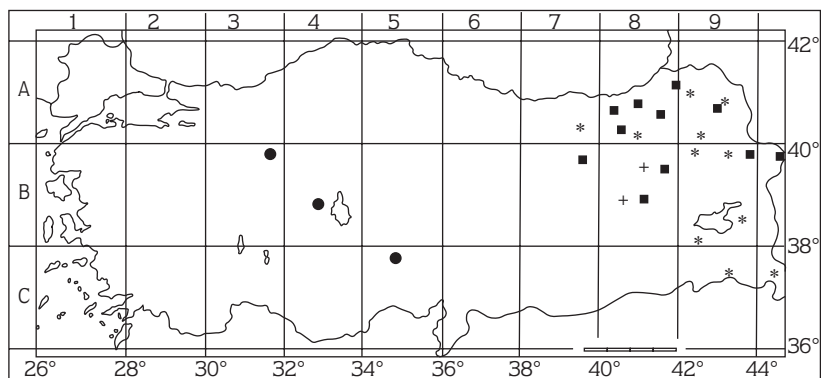


Figure 4. Distribution in Turkey (■) *A. incertus*, (*) *A. hyalolepis*, (+) *A. caudiculosus*, (●) *A. andrasovszkyi*.

Armenia: Aragaj, S'Hänge, Umgebung des Sees Sev-Litsch, 3328 m, 23.7.1947, *Narinjan* (W) - Alagez, beim See Kara-gel, 3250 m, 2.8.1932, *Busch* (W) - Alagez, am Fluß Dali-Tschaj, 2700 m, 20.7.1932, *Busch* (W) - in Monte Aragaz (Alagez), 3330 m, 23.7.1947, *Narinian* (M) - Distr. Ekhegnadzorsk, c. Gjadikvank, loco Sogaklug, SW'slope Gory Tschutscho, 23.7.1973, *Tamanjan & Kandhjan* (E) - Aragay, SW. slopes, 17.8.1961, *Manakjan* (E) - Getschamskij khrebet, NE. slopes G. Afdaak, 3400 m, 1947, *Akhverdov & Mirtschoeva* (E).

Azerbaijan: Nakhichevan: Distr. Schakhbuzck, Bichenakskij Pereval [Pass], 23.6.1974, *Menitzkij* (MSB).

Georgia: Elbrus-Gebiet, zwischen Itkol und "Piket 105", 3350 m, 26.7.1967, *Quasdorf 346* (B) - Prov. Tiflis, Distr. Achalkalaki, "Mokrie Gory", in monte Emlikli, 6.8.1921, *Grossheim* (K) - mt. Takhza-Takaro supra Bakuriani, prope Borzhom, viii.1921, *Kozlowsky* (K) - in monte Tskhra Takaro, Cataalinia, 8.7.1916, *Kozlowsky 914* (K).

Distribution: Turkey, Armenia, Azerbaijan, Georgia, Iran, Iraq. Irano-Turanian element.

It is the only member of the section with sub-bifurcate hairs on the leaflets. Therefore, it can be easily distinguished from other members.

2. *Astragalus hyalolepis* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 105. 1868 [et l.c. 15 (1): 185. 1869].

Syntypes: In Iberia, Alvar, *Wilhelms*; prope Trialeti, *E. Wiedemann* (LE, P: foto MSB!); ad lacum Goktscha ad pedem montis Tschitschaglu,

2000 m, *A.P. Owerin* (P: foto MSB!); ibid. *N. Von Seidlitz* (P: foto MSB!).

Lectotype: In Iberia, Alvar, *Wilhelms* (LE; iso: LE) (Podlech & Sytin, 1996).

= *A. subcaulescens* Ledeb., Fl. Ross. 1: 644. 1843, illeg. [non Benth.].

Syntypes: Iberia, *Wilhelms* (LE: = lectotype of *A. hyalolepis* Bunge); Somchetiae m. Besabdal, *K.E. von Eichwald* (Podlech & Sytin, 1996).

= *A. hyalolepis* subsp. *angustibracteata* Ponert, Feddes Repert. 83: 631. 1973.

Type: [Turkey] Bitlis to Tatvan, 1600 m, *P.H. Davis 43378* (E!, K!).

Figure 4,5.

Plants (5-)10-20(-30) cm, acaulescent or shortly caulescent, covered with unequally to equally bifurcate hairs. Caudex branched. Stems almost absent, concealed by the overlapping stipules, or up to 6 cm, erect, sulcate, loosely to densely covered with adpressed to sub-adpressed white hairs. Stipules whitish-hyaline, at the base light brownish, 5-10 mm, ovate to narrowly ovate, acuminate to subulate at the apex, free from the petiole, glabrous or sometimes with sparse white hairs at the margins and apex. Leaves 4-10(-15) cm; petiole 2-4(-7) cm, covered with adpressed to spreading white hairs. Leaflets 4-8-paired, flat, distant, narrowly elliptic to elliptic, acute at the apex, 5-13(-17) x 1.5-4 mm, sparsely hairy to glabrescent on upper side, loosely to densely covered with adpressed to sub-adpressed hairs on underside. Peduncle 5-12(-22) cm, sulcate, in lower part with sparse, predominantly white, in upper part with

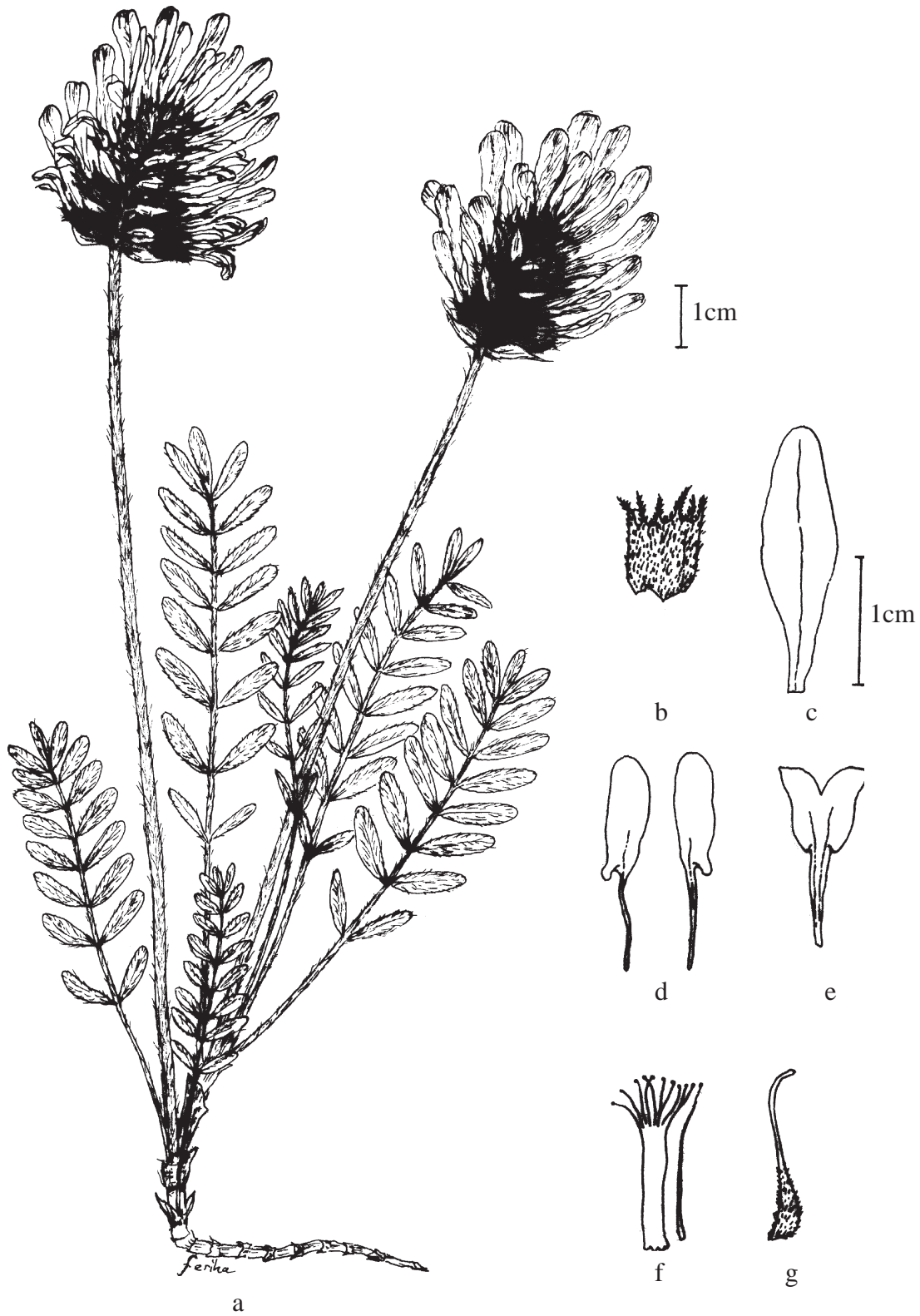


Figure 5. *A. hyalolepis*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

predominantly black hairs. Raceme ovoid to oblong, 10-20-flowered, 2.5-4 x 2-3 cm, slightly elongating in fruit. Bracts whitish-hyaline, ovate to narrowly ovate, shortly acuminate to subulate at the apex, grabrous or sparsely hairy. Pedicels c. 1 mm, hairy. Calyx whitish, 8-12 mm, tubular, loosely covered with adpressed white and black hairs, often with predominantly black hairs; teeth narrowly triangular to linear-acute, 2-4 mm, greenish, ± equal, on outer surface with predominantly black, on inner surface with white hairs. Petals violet, lilac or purple. Standard 22-28 x 5-7 mm, oblong to narrowly elliptic, rounded at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 15-21 mm, blades narrowly oblong, clearly constricted above the auricle, rounded at the apex, 10-13 x 3-4 mm, auricle 1.5-2 mm, claw 5-8 mm long. Keel 14-18 mm, blades obliquely elliptic, acute at the apex, 6-8 x 3 mm, auricle c. 1 mm, claw 8-10 mm. Stamens 10-18 mm, the free ends 4-5 mm. Ovary sessile, elliptic, white-hairs; style hairy only at the base. Fruits ovoid-oblong, 7-14 x 3-5 mm, laterally compressed, covered with spreading white and black hairs; beak 2-3 mm, curved. Seeds 3-4 mm, light brown, smooth.

Flowering time: 5-7. **Habitat:** Meadows, steppe; 1600-2800 m.

Specimens seen:

Turkey: [A8] Erzurum: 4 km from Tortum in the Aksu direction, 2250 m, 5.7.1975, *R. Çetik 5543* (KNYA) - *ibid.*, *M. Ekici 1996 & H. Akan* (GAZI) - Dumluca, c. 30 km Luftlinie N Erzurum, 2500-2800 m, 14.8.1982, *Sorger & Buchner 82-123-64* (W) - Aşkale, Kop mt., 2400 m, 29.6.1997, *M. Ekici 2002 & H. Akan* (GAZI, MSB) - [A9] Artvin: Ziyaret mt. (Yalnızçam mt.), between Ardahan and Artvin, 2200 m, 29.6.1957, *Davis 30288 & Hedge* (ANK, E, K, M) - Kars: Göle, between 4 church and Bellitepe, 2000 m, meadows, 7.7.1975, *R. Çetik 5546* (KNYA) - Susuz; between Hasköy and Susuz, 2020 m, 10.7.1975, *R. Çetik 5545* (KNYA) - 30 km W Çildir, 1900 m, 1.8.1982, *Sorger & Buchner 82-99-15* (W) - zwischen Sarıkamış und Karaorgan, bei der Abzweigung nach Gaziler, 1650 m, 6.7.1992, *Nydegger 46617* (MSB) - [B8] Erzurum: Sari Koma Pass, 2450 m, 2.7.1960, *Furse & Synge 846* (K) - Palandöken mt., 20-23 km from Çat in the Erzurum direction, 2300-2350 m, 27.7.1966, *Davis 47361* (K) - *ibid.* 29.7.1998, *M. Ekici 2128 & H. Akan* (GAZI) - Kop mt., NW Aşkale, 2400 m, 29.6.1997, *M. Ekici 2002 & H. Akan* (GAZI,

MSB) - 33 km from Eleşkirt in the Horasan direction, 2200 m, 30.6.1997, *M. Ekici 2008 & H. Akan* (GAZI, MSB) - [B9] Ağrı: 3 km E Ağrı, 1700 m, 1.6.1966, *Davis 44099* (E, K, M) - 2 km SW of Hamar (Murat valley), 1700 m, (fl. lilac), 3.6.1966, *Davis 44166* (E, K) - E. side of Tahir pass, 19 km from Eleşkirt in the Horasan direction, 2400 m, 24.7.1966, *Davis 47109* (E, K) - 3 miles W Ağrı, 29.6.1967, *J.G. Ross* (E) - Bitlis: Tatvan, Nemrut mt., N. slopes above the lake inside the crater, 2700 m, 18.7.1972, *Peşmen 2883* (E) - Van: between Van and Bitlis, Kuzgunkiran pass, 2235 m, 20.6.1986, *Ö. Seçmen 3481* (EGE, HUB) - [C10] Hakkari: 24 km from Yüksekova in the Şemdinli direction, 2050 m, 15.6.1966, *Davis 45118* (K).

Armenia: Ozero Sevan, Khrebet Areguni, 23.6.1959, *Akhverdov* (E) - Gory Arasan, 2200-2300 m, 21.5.1959, *Akhverdov & Leirsoeva* (K) - ad lacum Gockcha [Sevan] inter Semenoroka et Elenoroka, 20.6.1901, *Fomin* (M).

Distribution: Turkey, Azerbaijan, Georgia, Iran, Iraq, Turkmenistan. Irano-Turanian element.

It was difficult to determine the section to which this species belongs. It is noted that *A. hyalolepis* spreads outside Turkey. It is stated in the Flora of Turkey in a footnote that although the species is generally acaulescent and has large bracts, it can still be easily confused with some species of the section *Onobrychium*, such as *A. psoraloides*. However, some specimens of *A. hyalolepis* that we have studied have a distinct stem. It was decided to leave *A. hyalolepis* in the section *Hololeuce* as the fruit is equal to or shorter than the calyx, an important feature in that section. However, we have found the same characteristic in some species belonging to the section *Onobrychium*. This character is not therefore completely diagnostic between the 2 sections and this species could be placed in either section. It is hoped that further work on the revision of the section *Onobrychium* will solve the problem.

3. *Astragalus bicolor* Lam., Encycl. Méth. Bot. 1: 317. 1785.

≡ *Tragacantha bicolor* (Lam.) Kuntze, Revis. Gen. 2: 943. 1891.

Lectotype: 'Astragalus armeniacus incanus, angustifolius, fl. in eod. capitulo candid. et purpureo', Armenia, *J.P. de Tournefort* (P-LA; iso: B-W 14082, BM, MI, P-JUSS 15253, P-TRF nr. 3629: foto MSB!) (Podlech & Sytin, 1996).

Plants 6-25 cm, covered with equally to unequally bifurcate hairs. Caudex branched. Stems up to 1.5 cm, erect, densely covered with spreading white hairs, concealed by the overlapping stipules. Stipules whitish-membranous, 4-8 mm, triangular, acuminate-subulate at the apex, free from the petiole, with adpressed white hairs, later glabrescent. Leaves 2.5-12 cm; petiole 0.5-4 cm, densely covered with sub-adpressed white hairs. Leaflets 5-15-paired, flat or somewhat folded, oblong to narrowly elliptic, acute or obtuse at the apex, sometimes minutely mucronulate, 4-10 x 1-3 mm, densely covered on both sides with adpressed to sub-adpressed, silvery hairs, or sometimes with more sparse hairs on upper side. Peduncle (2-)5-23 cm, sulcate, densely covered with white hairs, toward the raceme also with some black hairs. Raceme globose to ovoid, 5-25-flowered, 1.5-3 x 1.5-2.5 cm, slightly elongating in fruit. Bracts membranous, yellowish-greenish, narrowly triangular, 5-11 mm, sparsely to densely covered with adpressed white or sometimes white and black hairs, at margin and apex with spreading white hairs. Bracteoles absent. Pedicels very short or up to 1 mm, hairy. Calyx whitish-yellow, 6-10 mm, campanulate-tubular, densely covered with long, spreading, sub-bifurcate white hairs and with short, adpressed white and some black hairs; teeth green, subulate, 3-5 mm, hairy like the tube, on inner side villous with sub-bifurcate white hairs. Petals whitish, lavender, bluish, violet or yellow. Standard 15-22 x 6-8 mm, elliptic to ovate, obtuse to acutish, retuse to emarginate at the apex, without differentiated claw, gradually narrowed at the base. Wings 11-15 mm, blades narrowly oblong-spathulate, widened toward the obtuse or retuse at the apex, constricted above the auricle, 8-10 x 2-4 mm, auricle 0.5-1 mm, claw 3-6 mm. Keel 9-12 mm, acute at the apex, 5-7 x 2 mm, auricle 0.5 mm, claw 4-6 mm. Stamens 10-12 mm, the upper 3-4 mm free. Ovary shortly stipitate, densely white-hairy; style hairy only at the base. Fruits ovoid to oblong, 8-11 x 3-4 mm, laterally compressed, densely covered with long, spreading, bifurcate white hairs; beak 2-3 mm, curved. Seeds 2-3 mm, dark green to brown, smooth.

1. Leaflets 8-15-paired; standard obtuse to acutish at the apex subsp. *bicolor*

1. Leaflets 5-8-paired; standard retuse to emarginate at the apex subsp. *karputanus*
subsp. *bicolor*

≡ *Tragacantha bicolor* (Lam.) Kuntze, Revis. Gen. 2: 943. 1891.

Lectotype (Podlech 1998): 'Astragalus armeniacus incanus, angustifolius, fl. in eod. capitulo candid. et purpureo', Armenia, *J.P. de Tournefort* (P-LA; iso: B-W 14082, BM, MI, P-JUSS 15253, P-TRF nr. 3629: foto MSBI).

Figure 6,7.

Flowering time: 6-7. **Habitat:** Steppe, fallow fields, stony places, meadows; 1500-3050 m.

Specimens seen:

Turkey: [A8] Erzurum: in montibus inter Erzurum et Ispir, prope Insk (Hinsk ?), 6.1853, *Huet du Pavillon* (W) - c. 14 km from Erzurum to Pasinler, 2000 m, 28.7.1966, *Davis 47443* (E) - between Oltu and Tortum, c. 2000 m, 12.7.1971, *S. Erik 1481* (AEF) - Oltu; around Uzunoluk, 1950 m, 6.7.1975, *R. Çetlik* (KNYA) - Tortum; between Yol Geçti and Soğuk Çermik, 1860 m, 5.7.1975, *R. Çetlik* (KNYA) - 60 km NW of Erzurum, around Kuzgunderesi, steppe, 2100 m, 10.7.1976, *A. Tatlı 4767* (ATA, HUB) - 25 km N Erzurum gegen Tortum, 2 km S Yeşildere, 1950 m, 27.7.1978, *Ehrendorfer, Sorger et al. 787-117-3* (MSB) - 30 km W Karayazi gegen Erzurum, 2200 m, 10.7.1988, *Nydegger 43691* (MSB) - 50 km from Erzurum in the Ispir direction, Eğerti village, around Kelkaya, 2000-2200 m, steppe, 19.7.1990, *Z. Aytaç 3197 & H. Duman* (GAZI) - 40 km from Erzurum in the Tortum direction, 2000 m, 28.6.1997, *M. Ekici 1990 & H. Akan* (GAZI, MSB) - ibid., 29.7.1998, *M. Ekici 2123 & H. Akan* (GAZI, MSB) - [A9] Kars: between Kars and Selim, 1800 m, 6.7.1967, *Davis 30657 & Hedge* (ANK, E, K, M) - Gölebert-Ardahan, c. 1800 m, *Davis 30415 & Hedge* (ANK) - Sarıkamış; between Karakurt and Şadvan village, 1700 m, 18.6.1980, *O. Güneş 1692* (HUB) - [B7] Erzincan: zwischen Çayırılı und Erzincan, Kovalık pass, 2350 m, 15.7.1988, *Nydegger 43779* (GAZI, MSB) - Sipikordagh, 5.7.1889, *Sintenis 1258* (K, W) - [B9] Ağrı: Suluçam (Musun) to Balik pass, 2150 m, 23.7.1966, *Davis 47250* (E, K) - between Ağrı and Erzurum, Tahir mt., c. 2475 m, 15.7.1972, *S. Erik 1984* (AEF, HUB) - 19 km E Taşlıçay, 1800 m, 24.7.1978, *Sorger 78-104-2* (W) - Bitlis: Pelli mt., above Pelli, 3050 m, 7.7.1954, *Davis 22484 & Polunin* (E, K) - Erzurum: 33 km from Eleşkirt in the Horasan direction, 2150-2200 m, steppe, 29.7.1998, *M. Ekici 2121 & H. Akan* (GAZI) - Van: Artos



Figure 6. *A. bicolor* subsp. *bicolor*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

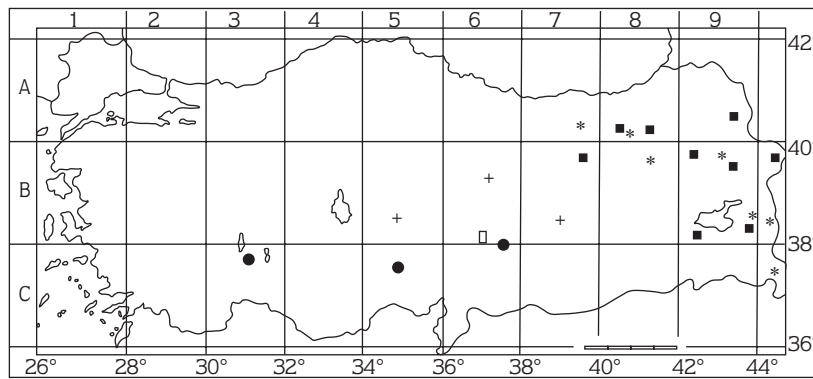


Figure 7. Distribution in Turkey (■) *A. bicolor* subsp. *bicolor*, (+) *A. bicolor* subsp. *karpitanus*, (*) *A. alyssoides*, (●) *A. cataonicus*, (□) *A. dumanii*.

mt., 2750 m, 14.7.1954, *Davis 22720 & Polunin* (K) - 2 km N Gürpınar (Havasor), 1900 m, shaley S slopes, 9.6.1966, (E) - 7 km from Van in the Erçek direction, 1850 m, 5.6.1966, *Davis 44391* (E, K) - [B10] Ağrı: 3-4 km E of Doğubeyazıt, 31.5.1966, *Davis 43959* (E) - 13 km E Doğubeyazıt, 1600 m, Basaltlava, 24.7.1978, *Ehrendorfer et al. 787-107-6* (W).

Iran: Azarbaijan Garbi: an der Grenze zur Türkei, Targevar - Jezni, 2550 m, 6.1991, *Zarre* (MSB).

Distribution: Turkey and Iran. Irano-Turanian element.

subsp. *karpitanus* (Boiss. & Noë) Ponert, Feddes Repert. 83: 631. 1973.

≡ *A. karpitanus* Boiss. & Noë, in Boissier, Diagn. pl. orient., ser. 2, 2: 26. 1856.

≡ *Tragacantha karpitana* ("Boiss." Boiss. & Noë) Kuntze, Revis. Gen. 2: 945. 1891. **Holotype:** prope Karpüt Armeniae mer., 6.1852, *F.W. Noë 963* (G-BOIS).

Figure 7,8.

Flowering time: 5-6. **Habitat:** Steppe, gypsum places; 1000-2200 m.

Specimens seen:

Turkey: [B5] Nevşehir: Göreme; Zelve, Aktepe, 1180 m, 20.6.1989, steppe, *M. Vural 5294* (GAZI) - ibid. 24.6.1998, *M. Ekici 2102 & Karavelioğulları* - [B6] Sivas: Gebirge SE von Ulaş, 47 km von Sivas gegen Malatya, 17.6.1939, *Reese* (B) - Ulaş, E of Tecer village, 19.7.1996, 1500 m, gypsum places, *M. Ekici 1919 & H. Akan* (GAZI) - Yozgat: Akdağmadeni, Nalbant mt., 2000-2200 m, *T. Ekim 3885 & A. Düzenli* (ANK) - [B7] Elazığ:

between Harput and Beşoluk, 1500 m, 28.7.1998, *M. Ekici 2117 & H. Akan* (GAZI, MSB).

Distribution: Endemic. Irano-Turanian element.

During field study, the similarity between these 2 species was noted. Moreover, in the Flora of Turkey, the similarity of *A. karpitanus* to *A. bicolor* is noted and it is stated as a footnote that one sample collected from Sivas by Simon was intermediate between *A. bicolor* and *A. karpitanus*. During our field work in the same region, after collecting some specimens we realised that these samples are similar to *A. karpitanus* in terms of leaflet number, whereas they are similar to *A. bicolor* in terms of other features. In other regions, the same situation was also observed. According to our observations the main and constant difference between these 2 species is only the number of leaflets. Leaflet number is not more than 8 for *A. karpitanus*, whereas it is not less than 8 for *A. bicolor*. Although it is not stated in the Flora of Turkey, another difference between these 2 species is shown by the standard; in *A. bicolor* it is obtuse to more or less acute at the apex, whereas that of *A. karpitanus* has a retuse to emarginate apex. This difference is constant for all examined and collected samples. We therefore follow Ponert in treating *A. karpitanus* as a subspecies of *A. bicolor*.

A. bicolor subsp. *bicolor* has a wider area of distribution than does subsp. *karpitanus*; the latter is also very scattered across the whole of its range. Moreover, this subspecies is under threat from excessive grazing, especially during the flowering period. Fruiting samples are therefore difficult to find. Thus this taxon will be at risk unless conservation measures are taken.

4. *Astragalus caudiculosus* Boiss. & A.Huet, in Boissier, Diagn. pl. orient., ser. 2, 2: 25. 1856.

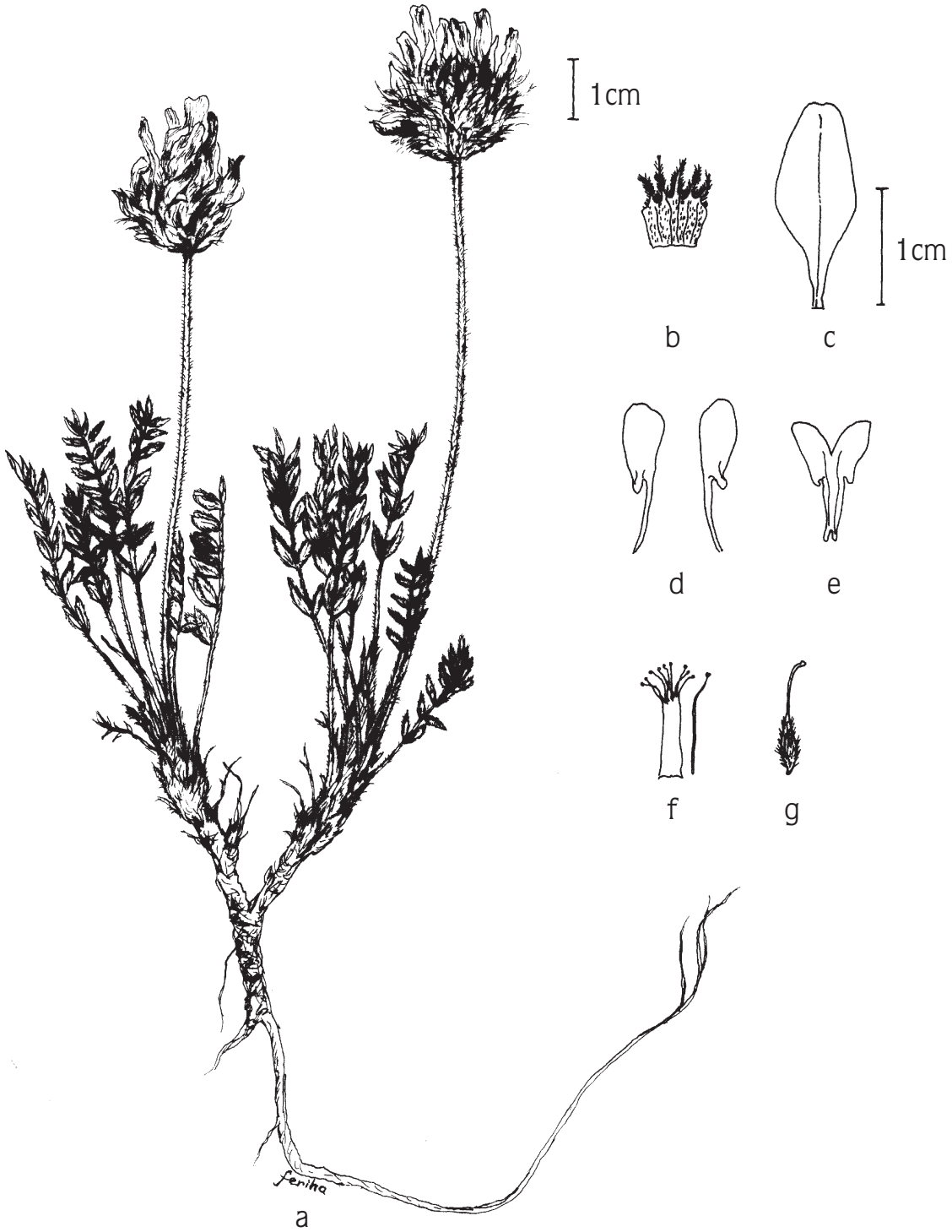


Figure 8. *A. bicolor* subsp. *karputanus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

≡ *Tragacantha caudiculosa* ("Boiss." Boiss. & A.Huet) Kuntze, Revis. Gen. 2:943. 1891.

≡ *A. xerophilus* Ledeb. subsp. *caudiculosus* (Boiss. & A.Huet) Ponert, Feddes Repert. 83: 631. 1973.

Holotype: [Turkey] Tech Dagħ prope Erzeroum Armeniae, 9000-10000', vii.1853, *A. Huet du Pavillon* (G-BOIS; iso: BM, G, GOET, KI, P: foto MSB!).

Figure 4,9.

Plants 4-10 cm, covered with equally or unequally bifurcate hairs. Caudex branched. Stems 1.3-5 cm, slightly sulcate, densely covered with adpressed white hairs, soon glabrescent to glabrous. Stipules whitish-membranous, 3-6 mm, ovate-triangular, free from the petiole, shortly acuminate to acute at the apex, sparsely white-hairy at first, soon glabrous. Leaves 1.5-5 cm; petiole 0.5-1.5 cm, sparsely covered with adpressed to spreading white hairs. Leaflets 5-11-paired, flat or somewhat folded, narrowly elliptic to elliptic, sometimes narrowly obovate, obtuse to acute at the apex, 3-10 x 2-3 mm, sparsely to densely covered on both surfaces with adpressed, short white hairs. Peduncle 1-7 cm, slightly sulcate, sparsely to densely covered with ± adpressed hairs that are predominantly white below and predominantly black on upper surface. Raceme globose, 5-10-flowered, 2-2.5 x 1.5-2 cm, slightly elongating in fruit. Bracts whitish-membranous, narrowly ovate, acute at the apex, 2-4 mm, with white hairs at the margins and apex, otherwise sparsely hairy or glabrous. Bracteoles absent. Pedicels up to 1.5 mm, hairy. Calyx greenish-yellow or whitish, 6-9 mm, tubular, covered on the dorsal side with adpressed hairs that are predominantly black, on the ventral side with almost white hairs; teeth linear-subulate, green, 0.5-1.5 mm, black-hairy on outer surface, white-villous on inner surface. Petals purple or violet. Standard 12-18 x 5-7 mm, narrowly rhombic-elliptic to rhombic, distinctly emarginate at the apex, without a differentiated claw, gradually narrowed at the base. Wings 10-14 mm, blades narrowly oblong, somewhat narrowed toward the obtuse apex, distinctly constricted above the auricle, 5-8 x 2 mm, auricle 1-1.5 mm, claw 5-7 mm. Keel 8-12 mm, acute at the apex, 4-6 mm, auricle 0.5 mm, claw as long as the blades. Stamens 9-13 mm, the upper 2-3 mm free. Ovary with a stipe 1 mm, with dense long white hairs;

style hairy only at the base. Fruits ovoid to oblong, 5-9 x 3-4 mm, laterally compressed, covered with spreading sub-bifurcate long white hairs and few adpressed short black hairs; beak c. 2 mm, curved. Seeds 2-3 mm, brown, smooth.

Flowering time: 7-8. **Habitat:** Meadows; 2100-3350 m.

Specimens seen:

Turkey: [B8] Bingöl: in monte Bingöl, 2750 m, 16.8.1959, *Kotschy suppl. 811* (W) - Erzurum: Palandöken mt., Pass M Aziziye, 2855 m, 19.7.1996, *Rasmont 104* (MSB) - W'Hänge des Büyük Ejder im Palandöken, 2790 m, 24.7.1973, *Holtz & al.* (E, EGE) - *ibid.*, 2800-2900 m, 29.7.1998, *M. Ekici 2134 & H. Akan* (GAZI, MSB).

Distribution: Endemic. Irano-Turanian element.

In the Flora of Turkey *A. caudiculosus* was placed in the section *Hololeuce* because it was considered to be acaulescent. Even so, it was considered to resemble *A. xerophilus*, a species that was placed in the section *Onobrychium*, as it is clearly caulescent. The Flora of USSR also placed *A. caudiculosus* in the section *Hololeuce*.

A. caudiculosus is said to differ from *A. xerophilus* in its longer, 15-19 mm, standard; in *A. xerophilus* the standard is 12-15 mm long. However, the present authors have observed that the stems of *A. caudiculosus* can be up to 3.5 cm long and the standard as small as 12 mm long. These characters are not therefore considered to be diagnostic in separating the 2 species. A more reliable character is the ratio of the fruit length to calyx length. In *A. caudiculosus* the fruit, which is 5-9 mm long, is about the same length as the calyx, which is 6-9 mm long. In *A. xerophilus* the fruit is 10-12 mm long in the authentic and type specimens that have been observed (not 4-5 mm as stated in the Flora of Turkey), and the mature calyx 4-5 mm long. This 2:1 ratio is more typical of most, though not of all the species in the section *Onobrychium*. For these reasons *A. caudiculosus* is here included in the section *Hololeuce* and *A. xerophilus* is kept in the section *Onobrychium* until further research is carried out.

5. *Astragalus andrasovszkyi* Bornm., Magyar Bot. Lapok 14: 54. 1915.

Lectotype: [Turkey] Lycaonia, Anatolia centr., ad pag. Karabagh, 17.5.1911, *Andrasovszky 442*

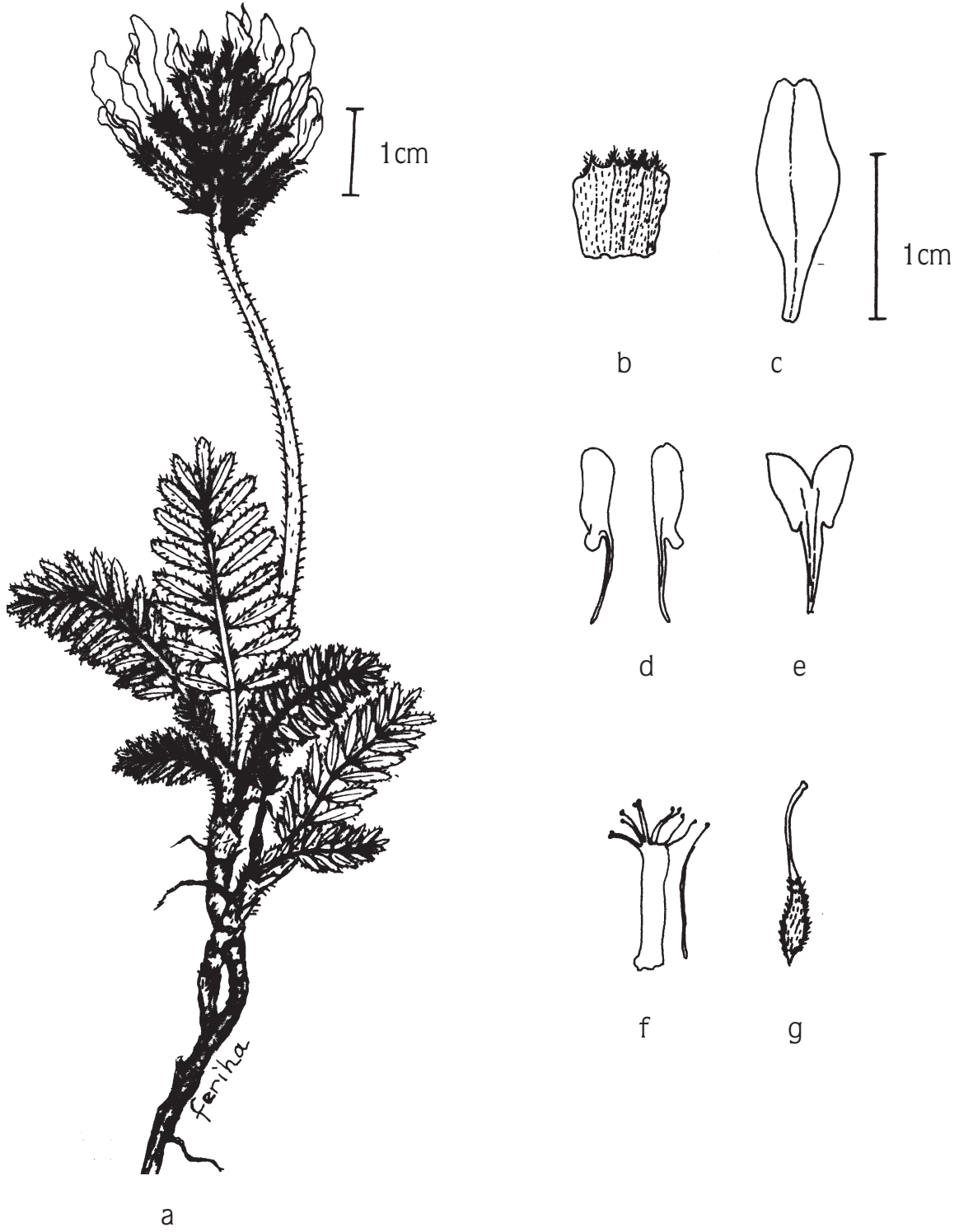


Figure 9. *A. caudiculosus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

(BI; iso: BP, JE).

= *A. vuralii* H.Duman & Aytaç, *Thaiszia* 1: 19. 1991.

Holotype: Turkey, B3 Ankara, 18 km W of Polatlı, Acıkır district, 840 m, 25.5.1990, *H. Duman & Z. Aytaç 3032* (GAZI! iso: ANKI!, HUBI!).

Figure 4,10.

Plants 4-17 cm, acaulescent to very shortly caulescent, densely covered with unequally to equally bifurcate hairs. Caudex branched. Stems mostly absent or up to 2 cm, erect, scarcely sulcate, densely covered with ± adpressed white hairs, concealed by the overlapping stipules. Stipules membranous, greenish-yellow, towards the apex greenish, 4-8 mm, ovate, acuminate to subulate at the apex, free from the petiole, with long spreading sub-bifurcate white hairs at the margins and apex, otherwise often wholly covered with adpressed white, rarely also with few black hairs. Leaves 1-12 cm; petiole 0.5-4 cm, covered with adpressed to spreading white hairs. Leaflets 3-8-paired, flat, narrowly elliptic to oblong or narrowly obovate, apex acute or minutely mucronulate, 4-15(-20) x 2-5 mm, on both sides silvery, with adpressed to spreading white hairs. Peduncle 2-13 cm, sulcate, densely covered with adpressed to spreading predominantly white hairs. Raceme ovoid to shortly oblong, 3-10-flowered, 2-3 x 1.5-2 cm, elongating in fruit. Bracts membranous, greenish to yellowish-greenish, narrowly triangular, 2-6 mm, densely covered with adpressed white and black or predominantly white hairs. Pedicels up to 0.5 mm. Calyx greenish or whitish-yellow, 7-10 mm, tubular-campanulate, covered with ± adpressed long white and short black hairs; teeth linear to subulate, green, ± equal, 2-3 mm, on outer surface with black and white, sub-bifurcate to bifurcate hairs, on inner surface sparsely covered with only simple white hairs. Petals white to cream or lilac. Standard 18-21 x 5-7 mm, elliptic, retuse at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 12-14 mm, blades narrowly oblong, constricted above the auricle, obtuse to rounded at the apex, 7-8 x 2-2.5 mm, auricle 0.5-1 mm, claw 5-7 mm. Keel 10-12 mm, acute at the apex, 5-6 mm, auricle c. 0.5 mm, claw as long as the blades. Stamens 10-11 mm, the upper 2-3 mm free. Ovary with a c. 0.5 mm stipe, densely white-hairy; style hairy only at the base. Fruits ovoid, 7-10 x 4-6 mm, laterally compressed, densely covered with long spreading, sub-bifurcate white hairs; beak 2-3 mm,

curved. Seeds 2-3 mm, brown, smooth.

Flowering time: 5. **Habitat:** Gypsum places, steppe; 840-1750 m.

Specimens seen:

Turkey: [B3] Ankara: Polatlı, Acıkır, 7.6.1983, *Y. Akman 13299* (ANK) - ibid. 13.5.1998, *M. Ekici 2061* (GAZI, MSB) - [B4] Konya: Cihanbeyli, around Karabağ, 1000-1050 m, 19.5.1998, *M. Ekici 2066* (GAZI, MSB) - ibid. 22.6.1998, *M. Ekici 2076* (GAZI) - [C5] Niğde: Ulukışla; Porsuk plateau, 1750 m, 19.7.1995, steppe, *Z. Aytaç 7151 & N. Adıgüzel* (GAZI).

Distribution: Endemic. Irano-Turanian element.

Before this study, *A. andrasovszkyi*, which is an endemic, was known only from the type that lacked fruit. Our field studies at the type locality of *A. andrasovszkyi*, especially with respect to the leaf, leaflet and peduncle sizes, allow us to provide an expanded description. This description completely overlaps with that of *A. vuralii*. The latter is therefore treated as a synonym of the former.

6. *Astragalus alyssoides* Lam., *Encycl. Méth. Bot.* 1: 317. 1785.

Lectotype: Armenien, "Astragalus orientalis, argenteus angustifolius, flore leucophaeo", *J.P. de Tournefort 29* (P-LA: foto MSB!; iso: BM; P-TRF nr. 3634!; foto MSB!) (Podlech, 1998).

= *A. elbrusensis* Boiss., *Diagn. pl. orient.*, ser. 1, 9: 45. 1849 ≡ *Tragacantha elbrusensis* (Boiss.) Kuntze, *Revis. Gen.* 2: 944. 1891.

Holotype: [Iran] in jugo Char Gerdene supra Asadbar, in parte occ. mt. Elburs, 8000', 9.7.1843, *Th. Kotschy 469* (G-BOIS; iso: G, GOET, KI MSBI, OXF, P, WI).

= *A. hololeucus* Boiss. & Buhse, *Nouv. Mém. Soc. Imp. Naturalistes Moscou* 12: 59. 1860 ≡ *Tragacantha hololeuca* ("Boiss." Boiss. & Buhse) Kuntze, *Revis. Gen.* 2: 945. 1891. **Syntypes:** [Iran] im Albursgebirge oberhalb Nur, 9500'. 17.6.1848, *F.A. Buhse 1035* (P: foto MSB!); ibid., *F.A. Buhse 1035a*.

Lectotype: [Iran] im Albursgebirge oberhalb Nur, 9500'. 17.6.1848, *F.A. Buhse 1035a* (G-BOIS; iso: LE: erronee sub *1034a*) (Podlech, 1998).

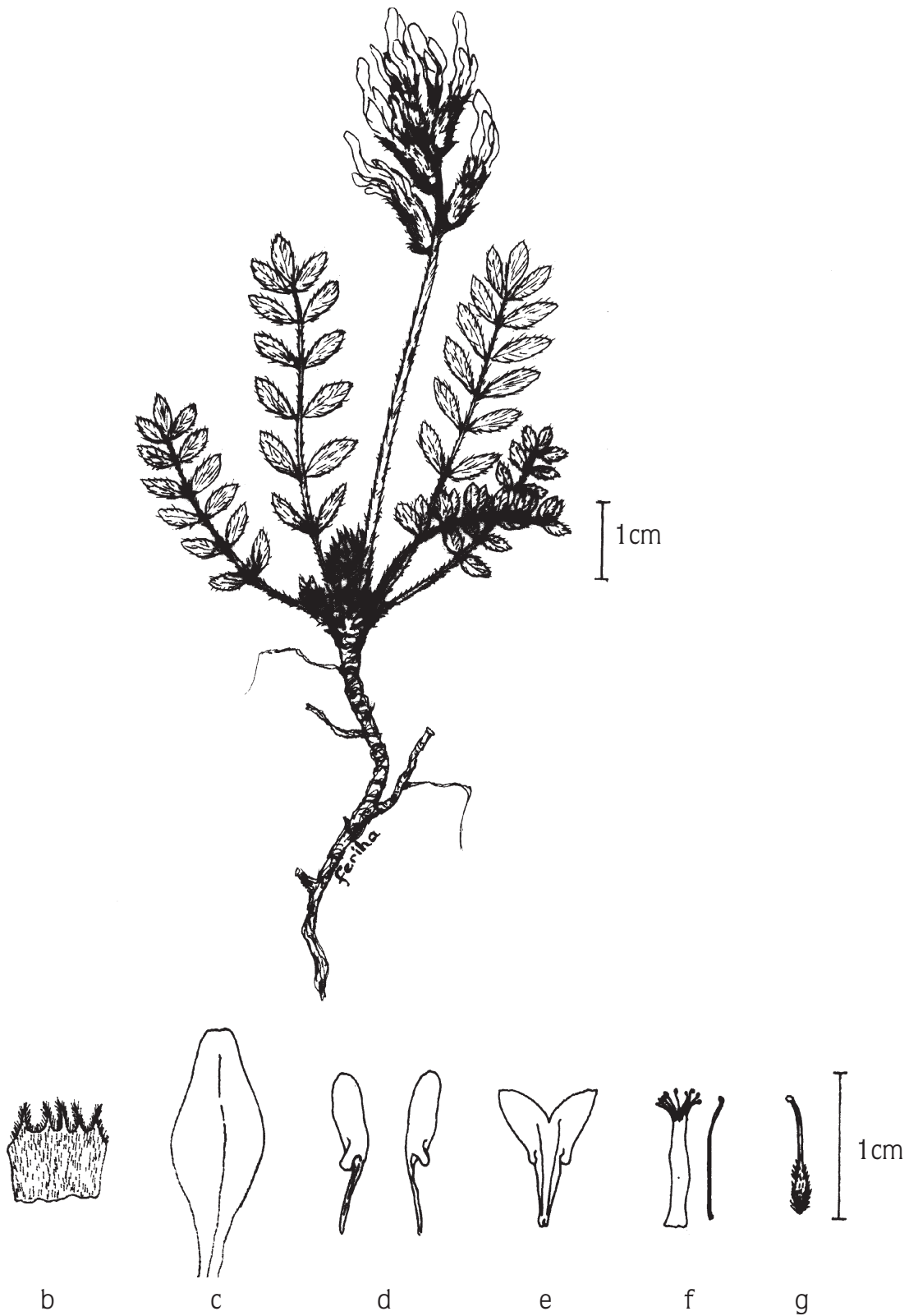


Figure 10. *A. andrasovszkyi*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

= *A. shishkinii* Grossh., in Grossheim & Schischkin, in schedis impr. ad Pl. Or. Exsicc. (ed. Grossheim & Schischkin) Fasc. 11: 18. 1928.

Lectotype: [Georgia] Transcaucasica, Georgia, Tiflis, prope Mtzchet, 20.5.1923, *B.K. Schischkin* in Pl. Or. Exs. no. 266 (LE; iso: BM, G, K!, LE) (Podlech & Sytin, 1996).

Figures: DeCANDOLLE, A.-P.: Astragalologia, Table 18, Figure 1. 1802.

Figure 7,11.

Plants 5-12 cm, acaulescent or shortly caulescent, densely covered with unequally to equally bifurcate hairs. Caudex strongly branched. Stems mostly absent or up to 5 cm, erect, sulcate, densely covered with adpressed to spreading white hairs. Stipules whitish-hyaline, 2-6 mm, narrowly triangular to triangular, acute to subulate at the apex, free from the petiole, with sparse to loose white hairs at the margins and apex, otherwise glabrescent to glabrous. Leaves 2-6 cm; petiole 0.5-1.5 cm, covered with adpressed to spreading white hairs. Leaflets 5-9-paired, flat to folded, narrowly elliptic to narrowly oblong, acute to obtuse at the apex, 4-7 x 1-2 mm, on both sides silvery, with adpressed to spreading hairs. Peduncle 2-12 cm, sulcate, covered with adpressed white and black, more rarely with only white hairs. Racemes globose to shortly cylindric, 10-30-flowered, 1-4.5 x 1-2 cm, elongating in fruit. Bracts whitish-hyaline, narrowly triangular, 2-4 mm, with sparse black and white hairs at the margins and apex, otherwise glabrous or very sparsely hairy. Bracteoles absent. Pedicels c. 1 mm, hairy. Calyx yellowish-white, 4-7 mm, tubular, densely covered with adpressed to spreading white hairs, sometimes also with a few black hairs; teeth narrowly triangular to linear-acute, green, ± equal, 1-2 mm, predominately black hairy, with white hairs inside. Petals white or lilac. Standard 9-12 x 4-6 mm, elliptic to rhombic-elliptic, emarginate at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 7-9 mm, blades narrowly obovate, slightly constricted above the auricle, retuse at the apex, 4-5 x 2.5 mm, auricle 0.5-0.7 mm, claw 3-4 mm. Keel 5-7 mm, obtuse at the apex, 3-4 x 1-2 mm; auricle 0.3-0.4 mm, claw as long as the blades. Stamens 5-8 mm, the upper 1-3 mm free. Ovary subsessile, densely white hairy; style hairy in the lower part. Fruit ovoid, 6-8 x 3-4 mm, laterally compressed, sparsely to densely covered with adpressed, short black

and white hairs and with spreading, long, sub-bifurcate white hairs; beak 1-2 mm, curved. Seeds 2-3 mm, brown and smooth.

Flowering time: 5-7. **Habitat:** Steppe, meadows, stony places; 1500-4000 m.

Specimens seen:

Turkey: [B8] Erzurum: Palandöken mt., meadows, 2700-2800 m, 1.7.1997, *M. Ekici 2014 & H. Akan* - ibid. 29.7.1998, *M. Ekici 2124 & H. Akan* - [B9] Ağrı: Mollakara, 20 km S Diyadin, 2050 m, 8.7.1988, *Nydegger 43628* (MSB) - Van: Artos mt., 3350-3500 m, 3.8.1966, *Tong 292* (E) - Tendürek Dag, an der Straße von Muradiye nach Doğubeyazit, 17.7.1981, *Rauss 4160* (B) - 2 km E Hoşap, 2100 m, 9.6.1966, *Davis 44559* (E, K) - 6 km from Özalp in the Saray direction, 2250 m, 5.6.1966, *Davis 44381* (E, K) - 36 km from Başkale in the Hoşap direction, N of Güzeldere pass, 2750 m, 3.7.1966, *Davis 45983* (E) - Başkale, Güzeldere pass, 2400-2800 m, 2.7.1983 *M. Koyuncu 6349 & M. Coşkun* (AEF) - [C10] Hakkari: Mor mt., 3250 m, 30.6.1967, *Mitchell in A.C. & W 2995* (E, K).

Azerbaijan: Sahend, 1820 m, 25.6.1929, *Cowan & Darlington* (K) - N. slopes of Kuh-i-Sahand, 2130 m, 25.5.1960, *Furse & Synge 237* (K) - above Zindjarab, Sahend Range, 25.6.1929, *Gilliat-Smith 2520* (K).

Iraq: Rowanduz District: Qandil Range, 3000-3200 m, 24.6.1957, *Rawi & Sarhang 24452* (K) - Top of Qandil Range, between top of Perrish and Bardamas, 3000 m, 29.8.1957, *Al-Rawi 24574* (K).

Iran: Khorasan: Shirvan, namanlou, Golule, Cheshme-Gabri, 2400 m, 19.7.1986, *Termeh, Moussavi & Tehrani 41378-E* (W) - Montes Kopet Dag inter Kuchan et Lutfabad, in jugo Alamlı, 2000 m, 14.7.1937, *Rechinger 1676* (K, W) - Kopet Dag, 25 miles N. of Quchan, 2130 m, 19.5.1966, *Furse 7508* (K) - Mazanderan: in regione alp. montis Tachtı-Soleiman, ad nives prope Häsartschal, 4000-4100 m, 29.6.1902, *Bornmüller 6837* (B) - in regione alpina montis Tachtı Soleiman, prope Häsartschal, 4000-4100 m, 29.6.1902, *Bornmüller 6857* (E, K, W) - inter Rescht et Kaswin, in monte Charsan, 2050 m, 13.5.1902. *Bornmüller 6858* (E, K, W) - Gilan: inter Rescht et Tehran, in jugo Charsan, 2050 m, 13.5.1902, *Bornmüller 6858* (B).

Turkmenistan: Ashkhabad: Central Kopet Dag, reg. Geoktepe, Missuni, 1600 m, 19.6.1953, *Nikitin* (as A.

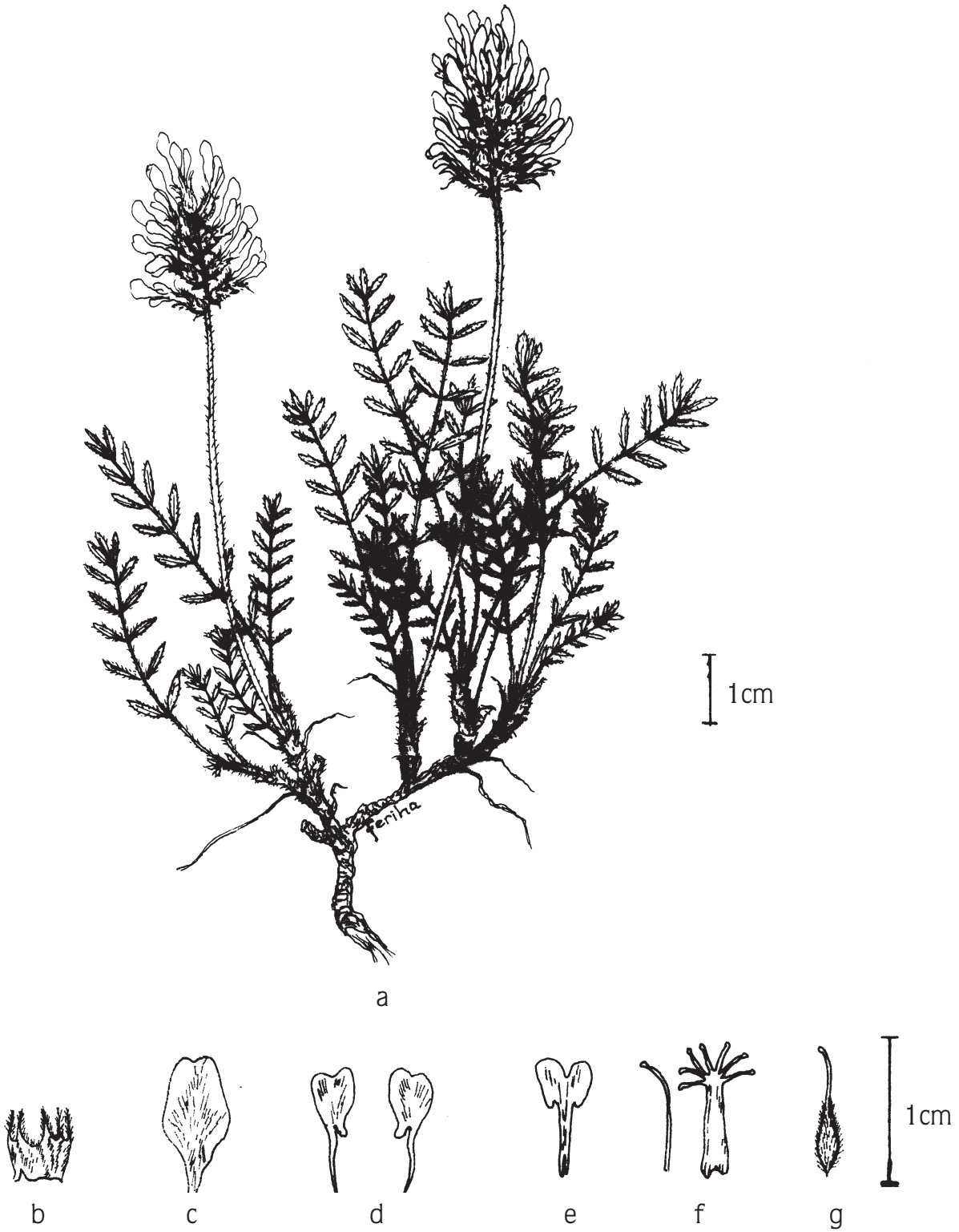


Figure 11. *A. alyssoides*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

elbrusensis Boiss.) (M) - in monte Ludsha, 2000 m, 7.6.1898, *Litwinow 1288* (W).

Distribution: Turkey, Azerbaijan, Georgia, Iraq, Iran, Turkmenistan. Irano-Turanian element.

7. *Astragalus cataonicus* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 107. 1868 [et l.c. 15 (1): 188. 1869].

≡ *Tragacantha cataonica* (Bunge) Kuntze, Revis. Gen. 2: 943. 1891.

Syntypes: in Tauro cilicico [in summo jugus inter Gisy deppe et Koschan, 2350 m], *Th. Kotschy 158* (K!); in Tauro cilicico, alpe 'Bulgar Dagh', in rupestribus montis Gisy Deppe, 8000', 1853, *Th. Kotschy 169*.

Lectotype: [Turkey] in Tauro cilicico, alpe 'Bulgar Dagh', in rupestribus montis Gisy Deppe, 8000', 1853, *Th. Kotschy 169* (P, foto MSB!; iso: MI, P, STU) (Podlech, 1998).

Figure 7,12.

Plants 2-5 cm, densely covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems up to 2 cm, erect, sulcate, densely covered with white hairs. Stipules yellowish-membranous, 5-7 mm, narrowly triangular to ovate, acuminate at the apex, free from the petiole, densely covered with adpressed white, sometimes also with black hairs near the base. Leaves 1-4 cm; petiole 0.3-1.5 cm, densely covered with sub-adpressed white hairs. Leaflets 4-8-paired, obovate to elliptic, acute at the apex, 4-7 x 2.5-4 mm, with silvery hairs on both sides. Peduncle 0.5-2 cm, sulcate, densely white-hairy. Raceme globose to ovoid, 20-40-flowered, 1.5-2.5 x 2-2.5 cm, not elongating in fruit. Bracts membranous, in lower part yellowish, in upper part green, narrowly triangular, 6-12 mm, densely adpressed white hairy, rarely with predominantly black hairs. Pedicels nearly absent. Calyx greenish-yellow, 10-14 mm, tubular, densely villous with long spreading, sub-bifurcate and short, adpressed white hairs, sometimes with also some adpressed black hairs; teeth linear-acute, green, equal, 5-7 mm, hairy like the tube. Petals lilac to purple. Standard 13-18 x 6-8 mm, rhombic-obovate, emarginate at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 10-16 mm, blades oblong-triangular, slightly narrowed towards the obtuse apex, clearly constricted above the auricle, auricle 1.5-2 mm, claw 5-8 mm. Keel 9-12 mm, acute at the apex, 4-6 x 2

mm, auricle c. 0.5 mm, claw 5-7 mm. Stamens 10-13 mm, the upper 3-4 mm free. Ovary with a stipe c. 0.5 mm, densely white hairs; style hairy only at the base. Fruits ovoid, 14-16 x 6-8 mm, laterally compressed, covered with long sub-bifurcate white hairs. Seeds 2-3 mm, brown and smooth.

Flowering time: 6-8. **Habitat:** Steppe, stony places; 2350-3400 m.

Specimens seen:

Turkey: [C3] Isparta: distr. Sütçüler, Dedegöl mt. above Dedegöl, 2700-2800 m, 3.8.1949, *Davis 16010A* (ANK, E, K) - ibid., 2400 m, 23.7.1997, *M. Ekici 2038 & Duran* (GAZI, MSB) - [B/C6] Adıyaman: in cacum. Karalea dicto montis Ak-dagh, 2700 m, 1.8.1889, *Bornmüller 1023* (B) - in monte Ak Dagh (= Aryly Tash) inter urbem Malatija et vicum Kjachta, 2600-2670 m, 17.7.1910, *Handel-Mazzetti 2354* (B)

Lebanon: Sattel zwischen Djebel Makhmel und Dj. Mneitri, 2600 m, 1.8.1937, *Bertschinger 4068* (B).

Distribution: Turkey, Lebanon. Irano-Turanian element.

In the original account Bunge described the stipules as being adnate to the petioles and therefore placed *A. cataonicus* in the section *Chlorosphaerus*. Nevertheless, after collecting additional material, and studying the types and further specimens from Lebanon, we considered that the species should be placed in a group in which at least some of the species have stipules that are free from the petiole.

8. *Astragalus dumanii* M.Ekici & Aytaç, Ann. Bot. Fennici 38:171-174, 2001.

Holotype: Turkey, prov. Maraş, [C6] Göksun, Berit Dağı, 2300-2400 m, 8.9.1997, *M. Ekici 2057 & Aytaç* (GAZI; iso: MSB).

Figure 7,13.

Plants 2-4 cm, acaulescent or nearly so, covered with equally to unequally bifurcate hairs. Caudex strong, branched. Stems almost absent or up to 1.5 cm, erect, sulcate, densely covered with ± adpressed white hairs, concealed by the overlapping stipules. Stipules whitish-hyaline, 5-8 mm, ovate to narrowly ovate, subulate to acuminate at the apex, free from the petiole, at the margins and apex with long, spreading, bifurcate white hairs, otherwise sparsely hairy to glabrous. Leaves 1-3 cm;

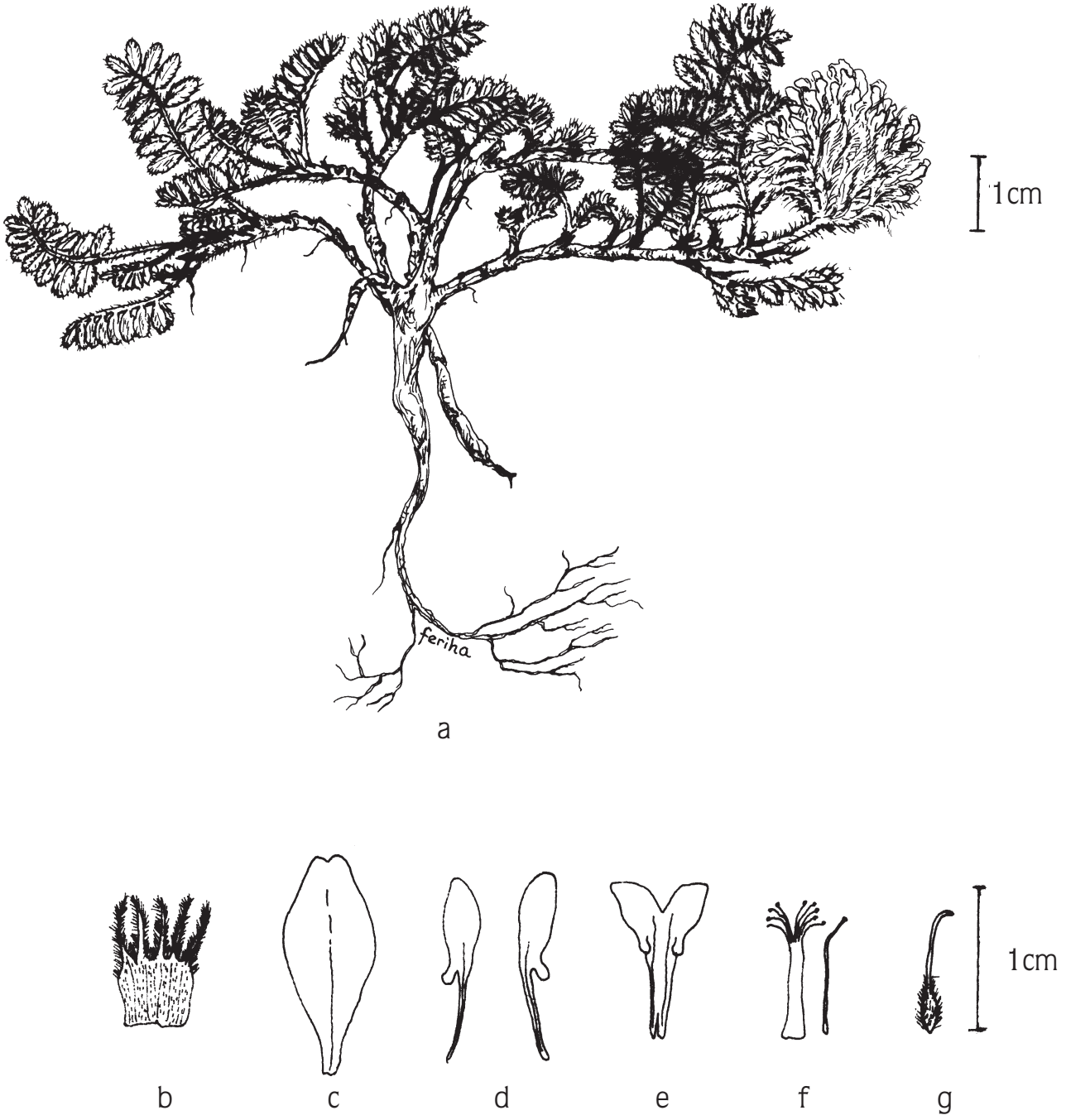


Figure 12. *A. cataonicus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

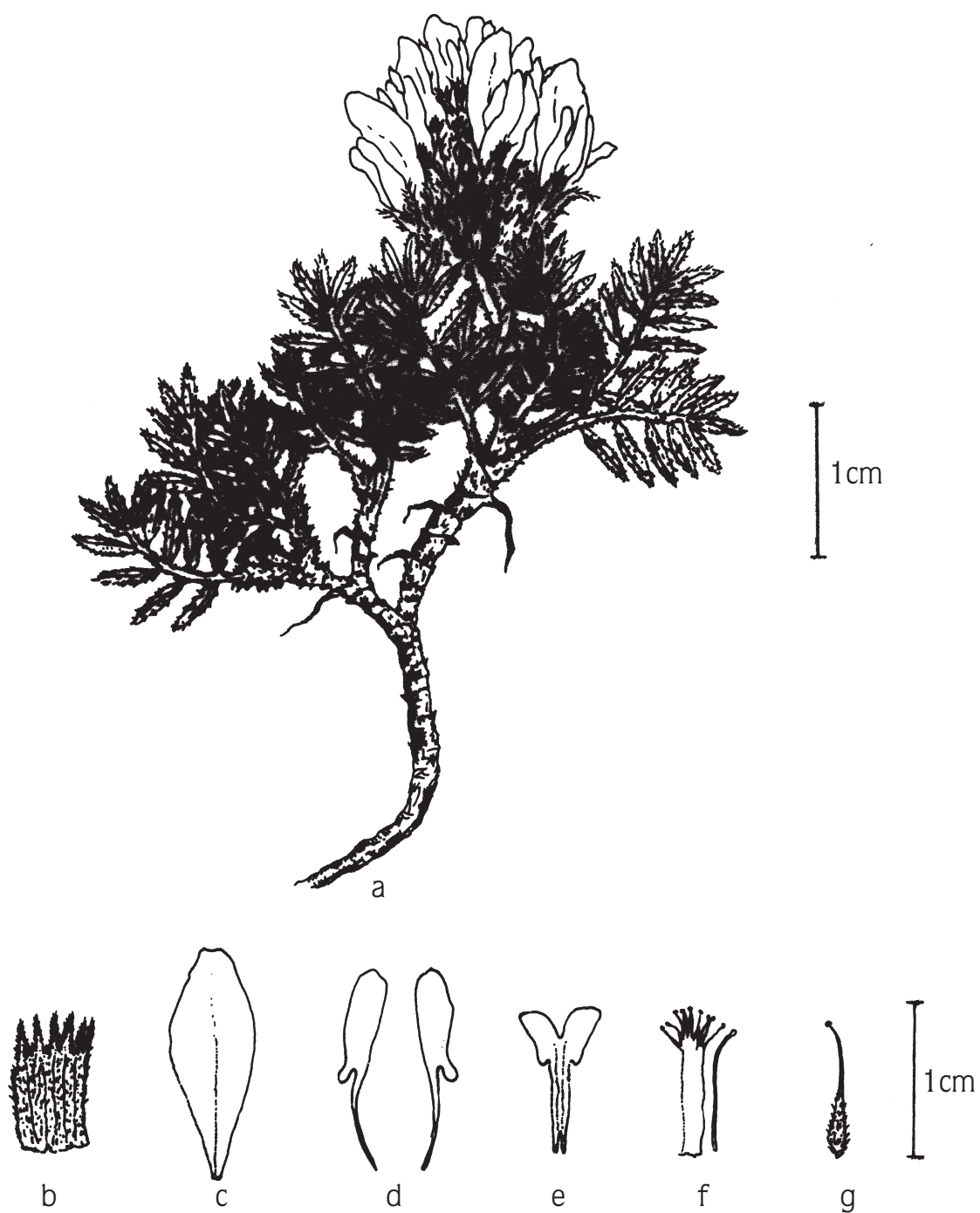


Figure 13. *A. dumanii*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

petiole 0.3-1 cm, densely hairy like the stem. Leaflets 3-7-paired, folded, linear to linear-elliptic, apex acute, 5-14 x 1-1.5 mm, densely covered on both sides with sub-adpressed white hairs. Peduncle 0.5-1.5 cm, sulcate, densely covered with adpressed to spreading white hairs. Raceme globose to ovoid, 10-25-flowered, 1-2 x 1-2 cm, not elongating in fruit. Bracts thinly membranous, in lower part whitish-yellow, in upper part greenish, narrowly triangular, 4-6 mm, adpressed white or predominantly white hairs. Bracteoles absent. Flowers sessile. Calyx yellowish or greenish-yellow, sometimes purplish-suffused, 7-10 mm, tubular, covered with adpressed black and white hairs; teeth linear-acute, green, equal, 2-4 mm, on outer surface with adpressed black and white hairs, with only white hairs within. Petals lilac. Standard 15-18 x 5-7 mm, elliptic, emarginate at the apex, without differentiated claw, gradually narrowed at the base. Wings 12-16 mm, blades narrowly oblong, clearly constricted above the auricle, obtuse at the apex, 6-8 x 2-3 mm, auricle 1-1.5 mm, claw 6-8 mm. Keel 9-12 mm, acute at the apex, 4-5 mm; auricle c. 0.5 mm, claw 5-7 mm. Stamens 10-12 mm, the upper 3 mm free. Ovary with a stipe c. 0.5 mm, densely white-villous; style hairy only at the base. Fruits narrowly ovate, 13-15 x 5-6 mm, dorsi-ventrally compressed, villous, with long, spreading, sub-bifurcate white hairs; beak c. 2 mm, slightly curved. Seeds ovoid to globose, c. 2 mm, light brown, smooth.

Flowering time: 7-8. **Habitat:** Steppe, scree; 2100-2600 m.

Specimens seen:

Turkey: [B6] Kayseri Binboğa mt., between Körkuyu and Sıçak plateau, 2400-2600 m, 21.7.1992, stony places, *Z. Aytaç 5434* & *H. Duman* (GAZI).

Distribution: Endemic. Irano-Turanian element.

In the original description, this species is thought to resemble *A. cataonicus* and the diagnostic features are given.

9. *Astragalus hirsutus* Vahl, *Symb. Bot.* 1: 59. 1790.

Lectotype: 'A. orientalis, candidissimus tomentosus', *J.P. de Tournefort* (P: hb. Vaillant: foto MSB!; iso: B-W 14080) (Podlech, 1998).

= *A. alindanus* Boiss., *Diagn. pl. orient.*, ser. 1, 2: 85. 1843 ≡ *Tragacantha alindana* (Boiss.) Kuntze, *Revis. Gen.* 2: 942. 1891 ≡ *A. hirsutus* subsp.

alindanus (Boiss.) Ponert, *Feddes Repert.* 83: 631. 1973.

Holotype: [Turkey] in Caria prope Moglah, Alindam veterum, *P.M.R. Aucher-Eloy 1326* (G-BOIS; iso: G, P).

= *A. chlorosphaerus* Boiss. & Noë, in Boissier, *Diagn. pl. orient.*, ser. 2, 2: 28. 1856 ≡ *Tragacantha chlorosphaera* ("Boiss." Boiss. & Noë) Kuntze, *Revis. Gen.* 2: 944. 1891.

Holotype: [Turkey] inter Karput et Sivas, VI.1852, *F.W. Noë 966* (G-BOIS).

= *A. hirsutus* subsp. *paraglobosus* Ponert, *Feddes Repert.* 83: 631. 1973.

Type: [Turkey] Kayseri, Bakır Da. above Kisge, *P. Davis 19340* (ANK!, EI, K!).

= *A. hirsutus* var. *hispidus* Freyn & Bornm., *Österr. Bot. Z.* 42: 48. 1892.

Syntypes: Tokat, 800-900 m, 13.5.1889, *J.F.N. Bornmüller 106*; Sivas, in monte Tschamlü-bel supra Yeni-chan, 1500 m, 1.6.1890, *J.F.N. Bornmüller (Z)*; Amasia, in monte Akdagh, 1200-1900 m, 22.5.1890, *J.F.N. Bornmüller 2102* (B!); Pontus galaticus, in mte. Abadschi Dag, 1500 m, 14.5.1890, *J.F.N. Bornmüller 2103* (B!).

Lectotype: [Turkey] Tokat, 800-900 m, 13.5.1889, *J.F.N. Bornmüller 106* (B!; iso: BRNU, G, JE, KI, LE, OXF, WI).

Figure 14,15.

Plants 2.5-10 cm, densely covered with equally to unequally bifurcate and sub-bifurcate hairs. Caudex strongly branched, more rarely unbranched. Stems absent or up to 1.5 cm, erect, scarcely sulcate, concealed by the overlapping stipules, densely covered with ± adpressed white hairs. Stipules whitish-yellow, membranous, towards the apex greenish, 7-11 mm, narrowly triangular, subulate to acuminate at the apex, adnate to the petiole for 4-6 mm, otherwise free from each other, at the margin and apex with dense to sparse white hairs, otherwise sparsely adpressed hairy to glabrous. Leaves 1-8 cm; petiole 0.2-4.5 cm, densely covered with adpressed short and spreading long white hairs. Leaflets 3-10-paired, flat or folded, oblong or narrowly elliptic to narrowly obovate, acute at the apex, 4-12 x 2-3 mm, on both sides silvery with adpressed to

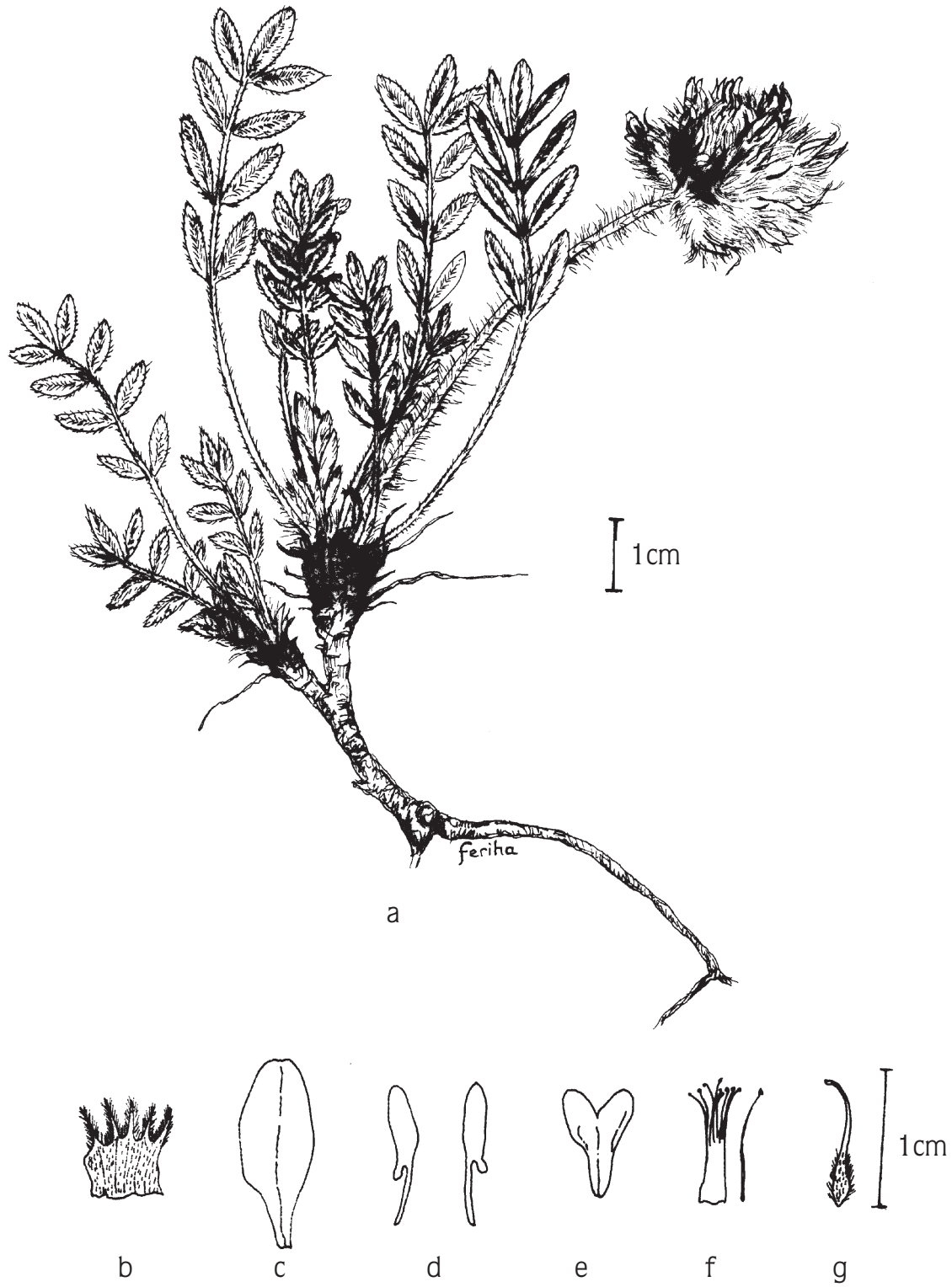


Figure 14. *A. hirsutus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

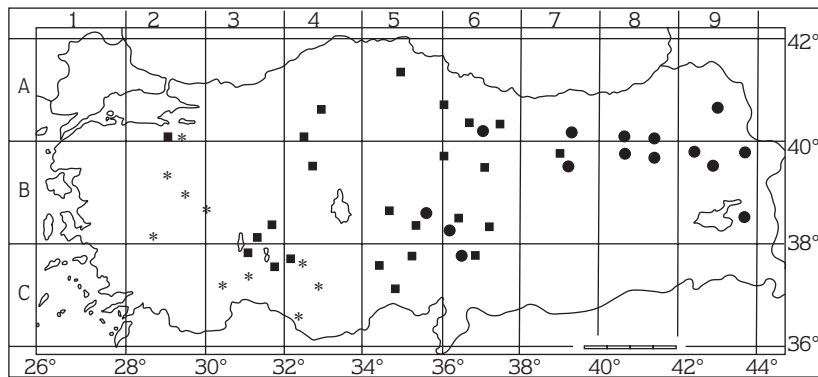


Figure 15. Distribution in Turkey (■) *A. hirsutus*, (●) *A. globosus*, (*) *A. sibthorpianus*.

spreading white hairs. Peduncle 1-5 cm, sulcate, densely covered with adpressed short white and black hairs and with spreading long white hairs that are 2-3 mm long. Raceme globose to ovoid, (7)10-20-flowered, 1-2.5 x 1-2.5 cm, not elongating in fruit. Bracts greenish or yellowish-greenish, membranous, linear-acute, 6-10 mm, densely covered with spreading long white hairs or sometimes with white and black hairs. Bracteoles absent or 1-2, linear, 2-4 mm, spreading white and black hairs. Pedicels up to 0.5 mm, hairy. Calyx yellowish or greenish-yellow, 6-10 mm, tubular-campanulate, densely covered with spreading, long, sub-bifurcate white hairs that are 2-3 mm long, and with short black and white hairs; teeth greenish, linear-acute, 2-3 mm, on outer surface hairy like the tube, on inner surface sparsely covered with only bifurcate white hairs. Petals yellow. Standard 14-18 x 6-8 mm, obovate or oblong-elliptic, retuse or emarginate at the apex, at the base with a slightly differentiated widely cuneate, claw 4-6 mm. Wings 11-14 mm, blades narrowly oblong, slightly narrowed toward the obtuse apex, distinctly constricted above the auricle, 6-9 x 1.5-2 mm, auricle 0.5-1 mm, claw 5-6 mm. Keel 9-12 mm, blades obliquely oblong, acute at the apex, 5-6 x 1-2 mm, auricle c. 0.5 mm, claw as long as the blades. Ovary shortly stipitate, densely white hairs; style hairy in the lower half. Fruits oblong to ovoid, 7-9 x 2-3 mm, laterally compressed, densely covered with spreading, white, sub-bifurcate hairs; beak 1-3 mm, curved. Seeds 2-3 mm, brown, smooth.

Flowering time: 5-7. **Habitat:** Steppe, open forest, meadows; 800-3200 m.

Specimens seen:

Turkey: [A2] Bursa: in summis jugis Olympi Bithyni, 8.1874, *Pichler*, Pl. rum. bithyn. 175 (K, W) - *ibid.*, *Aucher* 1377 (K) - *ibid.*, 12.8.1850, *Clementi* (E, K, W) - *ibid.*, 2000-2180 m, 18.6.1956, *Moore jr.* 7253 (E) - *ibid.*, 2300 m, 7.1978, *Polunin* 15006 (E) - [A4] Ankara: Ayaş mt., steppe, c. 1200 m, 19.5.1975, *Y. Akman* 6681 (ANK) - Ayaş pass, around Akyatak, 1300 m, 2.6.1988, *Z. Aytaç* 2270 (GAZI) - 50 km from Ankara in the Ayaş direction, 1200-1300 m, 1.6.1997, *M. Ekici* 1937 (GAZI, MSB) - Çankırı: pass between Çankırı and Ilgaz, 1520 m, 5.6.1954, *Davis* 21482 (E, K) - Karabük: Keltepe, 1850 m, 13.7.1984, *M. Demirörs* 1645 (ANK) - Kastamonu: K.Ilgaz mt., Yurttepesi, limestone, 2050 m, 30.6.1968, *F. Markgraf* 10617 (ANK) - Ilgaz, TV kulesi, 2000 m, 17.6.1982, *Y. Akman* 12355 (ANK) - [A5] Sinop: Köş mt., 2000 m, 1.6.1969, *Tobey* 2796 (E) - [A6] Amasya: in monte Ak-dagh, 1900 m, 15.7.1890, *Bornmüller* 2105 (B) - *ibid.*, 22.5.1890, *Bornmüller* 2102 (B) - Sivas: in m. Tschamlü-bel, 1500 m, 1.6.1890, *Bornmüller* 2104 (B) - Çamlıbel pass, slopes, 1200-1300 m, 3.6.1986, *Ş. Civelek* 2368 (CUM) - Çamlıbel pass, around Ilıca lake, 1550-1650 m, 1.6.1986, *Ş. Civelek*, 2238 (CUM) - [B3] Isparta: in monte Davros dagh Pisidia, v.1845, *Heldreich* (E, K, W) - *ibid.*, 30.5.1955, *Baytop* 4298 (E) - Dedegöl mt., 2200 m, 1.7.1965, *Sorger* 65-42-37 (W) - Kurestepe, 1500 m, 14.6.1966, *Sorger* 66-44-135 (W) - W der Passhöhe zwischen Gelendost und Akşehir, 1850 m, 29.5.1992, *Nydegger* 46117 (MSB) - Konya: Sultan mt., above

Akscheher [Akşehir], 1900 m, 21.6.1899, *Bornmüller 4394* (B, E, K, W) - Sultan mt., Doğanhisar, Gökgediktepe, 2000 m, 11.6.1979, *H. Ocakverdi 380* (KNYA) - [B4] Ankara: Beynam, 24.5.1971, 1300 m, *Y. Akman 346* (ANK) - [B5] Kayseri: Gemerek, Çat village, steppe, c. 1540 m, 8.6.1980, *T. Ekim 4942* (ANK) - Alidağ, 1700 m, steppe, 24.6.1997, *M. Ekici 1974 & H. Akan* (GAZI) - Nevşehir: 12 miles [S] from Ürgüp in the Akköy direction, 1600 m, 21.5.1965, *Coode & Jones 1277* (E) - [B6] Kahramanmaraş: Göksun; Binboğa mt., above Karlı Y. [Yaylak ?], 2500 m, 15.7.1952, *Davis 20032, Dodds & Çetlik* (K) - Göksun; Kaman mt., 2000 m, 20.6.1981, *B. Yıldız 3026* (HUB) - Kayseri: Pınarbaşı; Tersakan village, Hınzır mt., Üçkuyular, 1850 m, 18.5.1980, *N. Çelik 1113* (HUB) - Pınarbaşı; above Kaynar, 1750 m, 18.5.1980, *N. Çelik 1074* (ANK) - Sarız; Yalak, between Körkuyu and Sıçak, 2400-2600 m, 21.7.1992, stony places, *Z. Aytaç 5438 & H. Duman* (GAZI) - above Pınarbaşı, 1600 m, 7.7.1996, *M. Ekici 1915 & H. Akan* (GAZI, MSB) - ibid., 7.6.1997, *M. Ekici 1948 & Ö. Ekici* (GAZI, MSB) - Sivas: ad Sivas, 1892, *Bornmüller 3330* (B, E, K, W) - Gürün, 1400 m, 28.5.1960, *Stainton & Henderson 5256* (E, K) - 12 km S Gürün, 1800 m, 10.6.1973, *Sorger 73-33-44* (W) - E. flank of Tahtalı mt., 2000 m, 5.6.1977, *Watson 5552* (E) - bei Samakurd, zwischen Gürün und Kangal, 1620 m, 13.7.1982, *Nydegger 17103* (MSB) - Demiryazı village, around Yedigöz, 1500 m, limestone places, 28.5.1985, *N. Çelik 3174* (CUM, EGE, HUB) - 62 km N Gürün gegen Kangal, 1600 m, 8.6.1987, *Nydegger 42675* (MSB) - zwischen Gürün und Pınarbaşı, Ziyaret, 1900 m, 8.6.1987, *Nydegger 42683* (MSB) - Yozgat: Akdağmadeni to Büyük, Nalbant mt., 2100 m, 6.6.1965, *Coode & Jones 2102* (E) - [B7] Erzincan: Sipikordagh, 1820 m, 5.7.1889, *Sintenis 1255* (K, W) - Sipikör pass, 2400 m, 26.6.1934, *Balls 1548* (E, K) - Sipikör pass, zwischen Erzincan und Çavırlı, 2470 m, 26.6.1992, *Nydegger 46478* (MSB) - [C2] Antalya: Suçukdag, W Elmalı, 2000 m, 28.5.1963, *Sorger 63-35-39* (W) - Akdağ, 2500 m, *Sorger 68-26-59* (W) - ibid. 14.7.1968, *A. Pamukçuoğlu* (HUB) - Kuhu mt. S Elmalı, Gebiet von Çiğlikara, 13/15.6.1969, *Fitz & Spitzenberger 823* (W) - Elmalı, Susuz mt., 2000-2100 m, stony places, 4.6.1997, *M. Ekici 1938, H. Duman, A. Duran* (GAZI) - Denizli: Honaz mt., 2200 m, 25.5.1962, *Sorger 62-34-16* (W) - [C3] Antalya: between Cevizli and Akseki, 1500

m, 21.4.1989, *M. Koyuncu 15046* (AEF) - Isparta: Davros mt. 5.1845, *Heldreich* (E. K. W) - ibid. 30.5.1955. *Baytop 4298* (E) - Dedegöl mt., 2200 m, 1.7.1965, *Sorger 65-42-37* (W) - ibid. 2300-2400 m, 23.7.1997, *M. Ekici 2040 & A. Duran* (GAZI) - Çiçek mt., above Gedikli village, 1600-1700 m, 22.6.1998, *M. Ekici 2087 & A. Duran* (GAZI) - Konya: Beyşehir; between Kurucuova and Kirseciktepe, 1500 m, on rocks, 25.5.1981, *M. Serin 512* (KNYA) - 30 km W Konya gegen Beyşehir, 1520 m, 3.6.1992, *Nydegger 46157* (MSB) - 31 km from Beyşehir in the Akseki direction, 1400-1500 m, 10.6.1997, *M. Ekici 1955 & H. Akan* (GAZI, MSB) - [C4] Konya: Bozkır, Haydar mt., 2000 m, 12.6.1967, *R. Çetlik, E. Yurdakulol* (KNYA) - Bozkır, Yılanlıtepe, 1760 m, 15.5.1968, *R. Çetlik 6728, T. Ekim, E. Yurdakulol* (KNYA) - Bozkır; Üçpınar, 2.6.1969, *R. Çetlik 6726, T. Ekim, E. Yurdakulol* (KNYA) - [C5] İçel: Cilician Taurus, Burnjik, Kucuk Kur, 1680 m, 9.6.1934, *Balls 1346* (K) - Bolkar mt., Koçak, 2000 m, 1.6.1991, *Zielinski 9908* (MSB) - Konya: Ereğli, Aydos mt., around Tahtalı, 2500 m, 26.5.1978, *S. Erik, 2796* (HUB) - Niğde: am Demirkasik, bei Bereketli Maaden [Çamardı], 2000 m, 7.1910, *Siehe 263* (E, W) - Aladağ, Middle Narpiz Gorge, 2100 m, 20.6.1963, *Parry 106* (E) - Aladağ, 3130 m, 4.7.1965, *Wood & Gibson 155* (E) - [C6] Kahramanmaraş: Göksun; Çardak, Berit mt., 2500-2600 m, 3.6.1989, steppe, *Z. Aytaç 2655 & H. Duman* (GAZI) - Göksun; Ericek, around Arpaçukuru, 2200-2600 m, 23.6.1992, steppe, *Z. Aytaç 4908 & H. Duman* (GAZI).

Distribution: Endemic. Tri-regional (Black Sea, Medit. and Irano-Turanian).

The close relationship between *A. hirsutus* and *A. alindanus* referred to in the Flora of Turkey is confirmed by our research. In the Flora of Turkey *A. alindanus* is placed in a group of species characterised as having 2 bracteoles and a calyx more than 10 mm long, while *A. hirsutus* is included in a group with 1 bracteole and a calyx less than 10 mm long.

The characters used to delimit *A. alindanus*, a species only recorded from the provinces of Antalya and Muğla in grid square C2, from *A. hirsutus* have been shown to be more variable than allowed for in the description in the Flora of Turkey. This results from the limited number of specimens available to the authors of that work. In some

specimens of *A. alindanus* there are 4-5 pairs of leaflets, the bracteoles are absent and the calyx can be as small as 7 mm. On the other hand we have observed that *A. hirsutus* can have 2 bracteoles. We therefore conclude that *A. alindanus* should be treated as a synonym of *A. hirsutus*.

In the Flora of Turkey, attention was drawn to specimens of *A. hirsutus* that were collected by Wood in Niğde and by Davis in Kayseri and Maraş as they had 7-10 pairs of small leaflets. Ponert based the name *A. hirsutus* var. *paraglobosus* on these specimens. However, the specimen that he has designated as the type has leaflets that are 5-10-paired and 4-5 mm long; in both respects it falls within the range of *A. hirsutus*. Thus, the Ponert taxon is also treated as a synonym of *A. hirsutus*.

10. *Astragalus globosus* Vahl, Symb. Bot. 1: 60. 1790.

Lectotype: 'A. orientalis, foliis viciae argenteis, caule nudo, erecto floribus luteis',

J.P. de Tournefort (P-TRF 3644: foto MSBI; iso: B-W 14081, MI). – In C no material in the Vahlherbarium. (Podlech, 1998).

≡ *A. cylindraceus* DC., Astragalogia: 223. 1802.

Type: 'A. orientalis foliis viciae incanis, caule nudo erecto, floribus luteis' *J.P. de Tournefort* (vidi olim in hb. Desfontaines.) (P-TRF 3621, foto MSBI).

= *A. melinus* Boiss., Fl. Or. 2: 446. 1872 ≡ *A. cylindraceus* subsp. *melinus* (Boiss.) Ponert, Feddes Repert. 83: 631. 1973.

Syntypes: in monte Alidagh, 7 km SE de Césarée (Cappadoce) 1500 m, VII.1856, *B. Balansa 930* (sub nom. *A. cylindraceo*) (G, G-BOIS, GOET, MSBI, P: foto MSBI, WI); Cappadocia pr. Tehomakli ad radices Argaei, 5200', 31.5.1859, *Th. Kotschy Suppl. 218*. **Lectotype:** [Turkey] Cappadocia pr. Tehomakli ad radices Argaei, 5200', 31.5.1859, *Th. Kotschy Suppl. 218* (G-BOIS; iso: JE, P: foto MSBI, WI, ZT) (Podlech, 1998).

Figure 15,16.

Plants 7-27 cm, acaulescent or nearly so, covered with unequally to equally bifurcate hairs. Caudex strong,

only slightly branched. Stems absent or up to 2 cm, erect, scarcely sulcate, densely covered with ± adpressed white hairs, concealed by the overlapping stipules. Stipules membranous, whitish-yellow or greenish towards the apex, narrowly triangular to triangular, acuminate to subulate at the apex, adnate to the petiole for 3-5 mm, otherwise free from each other, at the margin and apex with spreading, long white hairs, otherwise with adpressed hairs, to glabrescent. Leaves 3-17 mm; petiole 0.5-5 cm, densely covered with adpressed short and with spreading long white hairs. Leaflets 7-18-paired, flat, narrowly elliptic to elliptic, acute at the apex, 6-13 x 2-5 mm, the younger ones densely covered on both sides with adpressed to sub-adpressed white hairs, soon ± glabrescent especially on the upper surface. Peduncle 5-24 cm, distinctly sulcate, covered with spreading, predominantly white hairs, in upper part sometimes with predominantly black hairs, soon glabrescent. Raceme globose to oblong, 15-40-flowered, 1.5-3.5 x 2-2.5 cm, slightly elongating in fruit. Bracts greenish-membranous, narrowly ovate, keeled, acute at the apex, 6-10 mm, with adpressed black and white hairs, sometimes soon glabrescent. Bracteoles absent or 2, 2-3 mm, linear-acute, black and white-hairy. Pedicels very short or up to 0.5 mm, hairy. Calyx whitish-yellow, 7-12 mm, tubular, densely covered with long sub-bifurcate white hairs and few adpressed short black hairs, sometimes on the ventral (upper) surface with only white and on the dorsal (lower) surface with predominantly black hairs; teeth linear-subulate, greenish, equal, 3-5 mm, on outer surface with spreading, long, sub-bifurcate white and with bifurcate black hairs, on inner surface only with sub-bifurcate white hairs. Petals yellow, not changing on drying. Standard 15-20 x 6-9 mm, oblong-obovate, emarginate at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 12-15 mm, blades narrowly oblong, distinctly constricted above the auricle, obtuse at the apex, 7-10 x c. 2 mm, auricle 1-1.5 mm, claw 4-6 mm. Keel 10-13 mm, blades obliquely oblong-obovate, obtuse to acute at the apex, 7 x 2 mm; auricle c. 0.5 mm, claw 4-6 mm. Stamens 10-14 mm, the upper 3-4 mm free. Ovary densely white hairs; style hairy in lower part. Fruits oblong to narrowly ovoid, 7-10 x 3 mm, laterally compressed, covered with long, spreading, bifurcate white hairs; beak 2-3 mm, curved. Seeds 2-3 mm, brown, smooth.

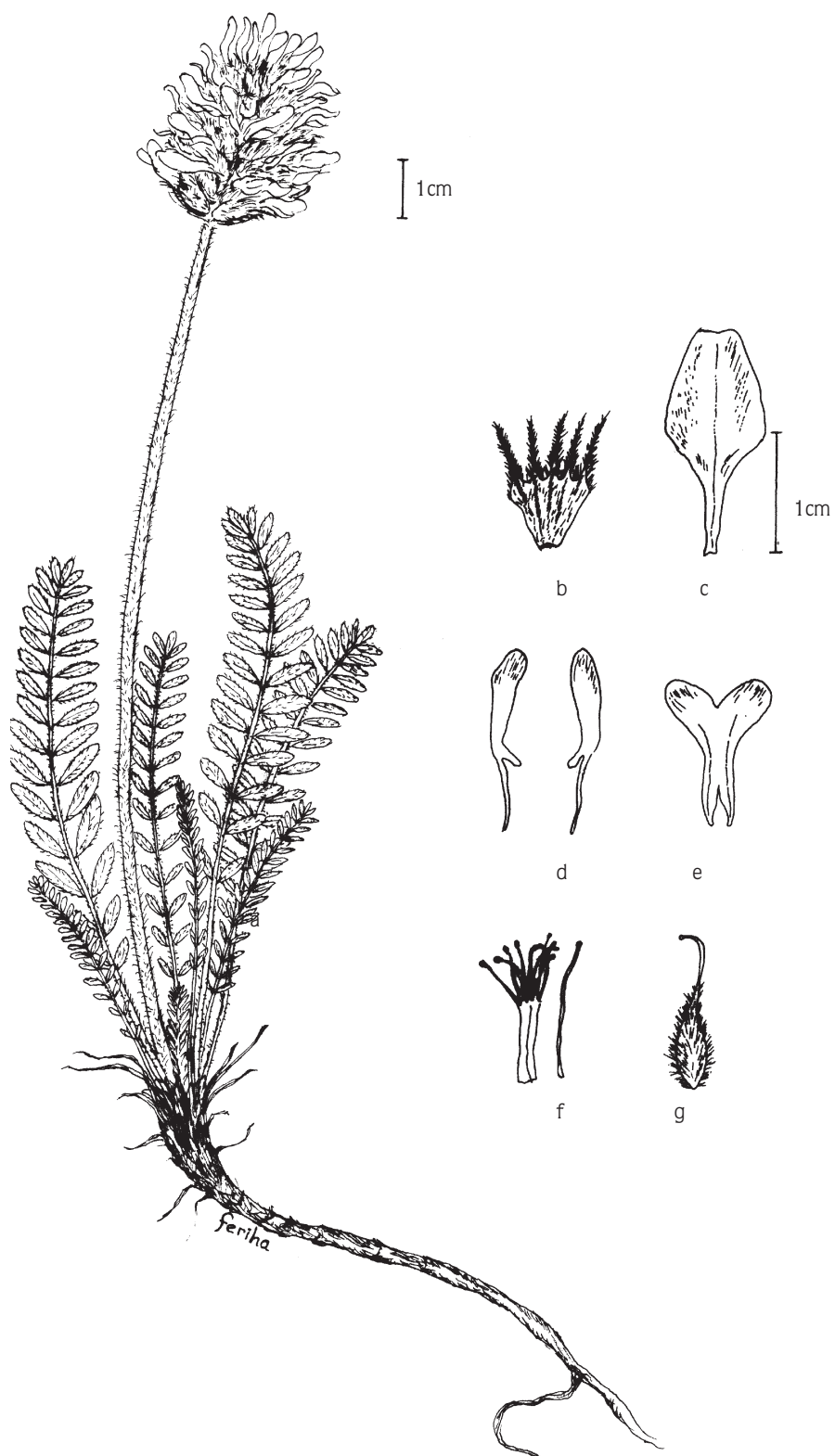


Figure 16. *A. globosus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

Flowering time: 5-7. Habitat: Steppe, stony places, meadows; 1500-3150 m.

Specimens seen:

Turkey: [A6] Sivas: mt. Yildiss-dagh, 2200-2500 m, 7.6.1890, *Bornmüller 2087* (K) - *ibid.*, 2000 m, 15.7.1969, *Sorger 69-58-82* (W) - *ibid.*, 29.7.1976, *Sorger 76-8-24* (W) - 24 km W Suşehri gegen Zara, 1660 m, 3.6.1990, *Nydegger 45618* (MSB) - [A7] Gümüşhane: prope Gümüşchane, 1520-1680 m, 5.1853, *Huet du Pavillon* (K) - [A8] Bayburt: Kop pass, zwischen Aşkale und Bayburt, 2400 m, 13.7.1988, *Nydegger 43744* (MSB) - 6 km N des Kop pass, zwischen Aşkale und Bayburt, 2050 m, 28.5.1990, *Nydegger 45573* (MSB) - c. 25 km NW Aşkale, unterhalb des Kop mt. Passes, 2300 m, 23.6.1987, *D. Lange 3644* (MSB) - *ibid.* *M. Ekici 1999 & H. Akan* (GAZI) - Erzurum: S of Aynalıkale village, Ziyaret mt., 2450-2650 m, steppe, 11.8.1976, *A. Tatlı* (ATA, KNYA) - Gavur mt., Ortaveren village, 2650-3100 m, 21.7.1977, *A. Tatlı 5758* (ATA, HUB) - Tortum; Kabaktepe village, 2100-3150 m, 10.7.1977, *A. Tatlı 5652* (ATA, HUB) - 25 km from Erzurum in the Ispir direction, 2300 m, 25.7.1996, *M. Ekici 1928 & H. Akan* (GAZI, MSB) - between Erzurum and Tortum, around Taşbaşı, 2050 m, 28.6.1997, *M. Ekici 1991 & H. Akan* (GAZI, MSB) - [A9] Kars: Distr. Oltu, prope p. Bardus, 23.6.1911, *Sosnowsky* (K) - Surb Khach *Litvinov* (foto MSB) - [B5] Kayseri: in regione alpina montis Argaei, 2200 m, 18.6.1890, *Bornmüller 1631* (W) - Alıdağ, 1750 m, 7.7.1996, *M. Ekici 1910 & H. Akan* (GAZI, MSB) - *ibid.*, 1850 m, 10.6.1987, *Nydegger 42730* (MSB) - oberhalb Kayseri gegen Develi, 1800 m, 10.6.1992, *Nydegger 46218* (MSB) - Yılanlı mt., 1350-1500 m, 22.6.1992, *A. İnce 360* (GAZI) - [B6] Kayseri: Sarız; Yalak, Binboğa mt., around Tekkekayası, 2200-2250 m, 1.10.1992, *Z. Aytaç 5109 & H. Duman* - [B7] Erzincan: Egin [= Kemaliye]; Jokardidagh, 6.6.1890, *Sintenis 2536* (W) - [B8] Erzurum: Pass over Çoruh watershed, 10 miles SW Ispir (Gölyurt pass), 2620 m, 2.7.1964, *Watson 307* (E, K) - Palandöken mt., 20-23 km from Çat in the Erzurum direction, 2300-2350 m, 27.7.1966, *Davis 47362B* (E, K) - Spitze des Büyük Ejder dağ im Palandöken, 3200 m, 26.7.1973, *Holtz et al. 858* (E) - Palandöken mt. S Erzurum, 2200 m, Schiefer, 26.7.1978, *Ehrendorfer & al. 787-113A-24* (MSB) - vor Ispir an der Straße nach

Erzurum, 2200 m, 19.8.1987, *Engel 150* (B) - c. 9 km S Chasan-Kale (Pasinler), Palandöken mt. E Erzurum, 20.6.1987, *D.Lange 3592* (MSB) - Palandöken mt., 2450 m, 29.7.1998, *M. Ekici 2127 & H. Akan* (GAZI, MSB) - Bingöl: Bingöl mt., Beritan plateau, 3000 m, 22.8.1983, *T. Ekim 7891* (ANK) - [B9] Ağrı: Tahir mt., steppe, 2500 m, 7.1989, *H. Özçelik* (EGE) - zwischen Ağrı und Akhav, oberhalb Saribulak, 2300 m, 2.7.1992, *Nydegger 46564* (MSB) - Erzurum: 33 km from Eleşkirt in the Horasan direction, 2150-2200 m, steppe, 30.6.1997, *M. Ekici 2009 & H. Akan* (GAZI) - Van: Artos mt., 3050 m, 16.7.1954, *Davis & Polunin D.22752* (E, K) - *ibid.*, 2750 m, 14.7.1954, *Davis 22720 & Polunin* (E) - [C6] Kahramanmaraş: Ahır mt., Ulucaktepe, around Balacak, 1200-1500 m, 21.5.1992, *Z. Aytaç 4588 & H. Duman* (GAZI, HUB) - Göksun; Değirmendere, Fındıklıkoyak village, open places in *Quercus*, 1500-1600 m, 18.5.1993, *M. Ekici 1319* (GAZI).

Distribution: Endemic. Irano-Turanian element.

In the Flora of Turkey *A. cylindraceus* is keyed out in error as having 2 bracteoles; this is at variance with the description where the bracts are described as being absent or up to 5 mm. We have found that several specimens are intermediate between *A. globosus* and *A. cylindraceus* and cannot be placed with certainty in either species. We therefore reduce the latter to a synonym of the former species.

11. *Astragalus sibthorpianus* Boiss., *Diagn. pl. orient.*, ser. 1, 2: 84. 1843.

≡ *Tragacantha sibthorpiana* (Boiss.) Kuntze, *Revis. Gen.* 2: 948. 1891.

Syntypes: in Olympe Bithyno, *J. Sibthorp*; *ibid.*, *P.M.R. Aucher-Eloy 1348* (BM, G-BOIS, KI, LE, MSBI, OXF, P); *ibid.*, VII.1842, *E. Boissier*.

Lectotype: [Turkey] in Olympe Bithyno, VIII.1842, *E. Boissier* (G-BOIS; iso: G-BOIS, GOET, KI, LE, M!, P) (Podlech, 1998).

= *A. paecilanthus* Boiss. & Heldr., in *Boissier, Diagn. pl. orient.*, ser. 2, 6: 54. 1859 ≡ *Tragacantha paecilantha* ("Boiss." Boiss. & Heldr.) Kuntze, *Revis. Gen.* 2: 947. 1891.

Syntypes: Davros Dagh Pisidiae, 1530 m, 26.5. (fl.) (KI, OXF); *ibid.*, 6.6. (fr.) 1845, *T.H.H. von*

Heldreich (G-BOIS, KI, P, WI); Ouchak [Usak] Phrygiae, alt. 3000', 26.5. & 6.6.1857, *B. Balansa 1127* (BI, BM, G, JE, KI, LE, MSB!, OXF, P, WI); Davros Dagħ Pisidiae, 5000-6000', 28.5.1848, 5.1848, *T.H.H. von Heldreich*.

Lectotype: [Turkey] Davros Dagħ Pisidiae, 5000-6000', 28.5.1848, 5.1848, *T.H.H. von Heldreich* (G-BOIS; iso: LE, WI) (Podlech, 1998).

= *A. wallianus* Bornm. & Reese, Repert. Spec. Nov. Regni Veg. 43: 151. 1938.

Type: [Turkey] Phrygia, Uschak, 30 km E der Stadt, 5 km S Banias, 7.6.1935, *H. Reese & E. Wall* (BI, JE).

Figure 15,17.

Plants 2.5-15(-20) cm, densely covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems up to 8 cm, rarely absent, erect, sulcate, covered with adpressed white hairs. Stipules membranous, greenish-yellow, toward the apex greenish, brownish when dry, 4-10 mm, ovate to narrowly triangular, acuminate at the apex, adnate to the petiole for 2-3 mm, free from each other or behind the stem only connate at the base, sparsely to densely hairy, later glabrescent. Leaves (1-)3-10 cm; petiole 0.3-3 cm, covered with long spreading and short adpressed white hairs. Leaflets 7-13-paired, narrowly elliptic to narrowly obovate or elliptic, acute or very minutely mucronulate at the apex, 3-10 x 1-4 mm, on upper side sparsely hairs or glabrous, on underside densely covered with adpressed to spreading white hairs. Peduncle 0.5-10(-14) cm, slightly sulcate, mostly densely or rarely sparsely covered with spreading white and short black hairs. Raceme globose to ovoid, densely 15-40-flowered, 1.3-2 x 1-2 cm, not elongated in fruit or only slightly so. Bracts membranous, yellowish, with greenish tip, narrowly triangular, 5-8 mm, at the margin and apex or more rarely in the upper part or all over with spreading white or white and black hairs. Pedicels 0.2-1 mm, hairy. Bracteoles absent or only one, linear-acute, 3-4 mm, hairy. Calyx yellowish-white, suffused with purple, 7-12 mm, campanulate-tubular to tubular, the tube sparsely to densely covered with spreading white hairs, sometimes with few additional black hairs; teeth subulate, green, 3-5 mm, covered with predominantly spreading white hairs and with some adpressed black hairs, on inner surface only white hairs. Petals red or whitish yellow, soon turning pink or purple.

Standard 12-18(-20) x 3-5 mm, oblong, to oblong-elliptic, retuse to emarginate at the apex, without clearly differentiated claw, gradually narrowed at the base. Wings 9-14 mm, blades narrowly oblong, constricted above the auricle, obtuse at the apex, 6-9 x 1-2 mm, auricle 0.5-1 mm, claw 3-5 mm. Keel 8-12 mm, blades obliquely elliptic, acute at the apex, 4-6 x 2 mm, auricle 0.3-0.5 mm, claw as long as the blades. Stamens 10-11 mm, the upper 2-3 mm free. Ovary sessile to subsessile, elliptic, densely white hairs; style hairy only at the base. Legumes sessile, narrowly ovoid, 6-10 x 2-3 mm, laterally compressed, densely covered with crispate, adpressed, white hairs; beak 1-2 mm, straight. Seeds 2-3 mm, brown, smooth.

Flowering time: 5-7. **Habitat:** Open forest, stony places, meadows; 950-2300 m.

Specimens seen:

[A2] Bursa: in mt. Olympos Bithynio (Uludağ), 17.8.1852, *Clementi* (E, K) - *ibid.*, vii.1873, *Pichler* (K) - *ibid.*, 2500 m, 30.7.1960, *Fitz* (W) - *ibid.*, 2100-2200 m, 21.7.1998, *M. Ekici 2113 & H. Akan* (GAZI, MSB) - *ibid.* 13.8.1998, *M. Ekici 2139 & H. Akan* (GAZI, MSB) - [B2] Denizli: between Çivril and Akkaya, 1400 m, 7.6.1983, *Y. Gemici 2193* (EGE) - Kütahya: Murat mt. above Banaz, 2000 m, 15.6.1965, *Coode & Jones 2505* (E) - *ibid.*, 1800-2000 m, 15.7.1997, stony places, *M. Ekici 2032 & H. Akan* (GAZI) - Muratdagħi oberhalb Çamsu, 1280 m, 25.5.1992, *Nydegger 46071* (MSB) - [B3] Afyon: between Afyon and Uşak, 1000 m, 11.6.1975, *R. Çetik* (KNYA) - between Afyon and Eğirdir, Bozdurmuş pass, 1550 m, 28.5.1992, *Nydegger 46105* (MSB) - [C3] Burdur: between Burdur and Antalya, around Kaplanboğān, 24.5.1938, *A. Heilbronn et M. Başarman 497* (ISTF) - Isparta: Dedegöl mt., 1600 m, 15.6.1966, *Sorger 66-46-9* (W) - *ibid.*, 2400 m, 8.7.1970, *Sorger 70-46-51* (W) - *ibid.* 23.7.1997. *M. Ekici 2036 & A. Duran* - Eğirdir, between Ağılköy and Yılanlı, *P. nigra* forest, 18.5.1973, *H. Peşmen 3413 & A. Pamukçuođlu, S. Erik* (HUB) - Eğirdir, Yaka village, above Çamova, 1600-1980 m, 2.7.1974, *H. Peşmen 1607 & A. Güner* - Çiçek mt., above Gedikli village, 1600-1800 m, 22.6.1998, *M. Ekici 2086 & Duran* (GAZI, MSB) - Konya: Beyşehir; Kurucuova, Suludere, steppe, 1500-2000 m, 8.6.1975, *H. Peşmen 2204 & A. Güner* (ANK, AEF, HUB) - 7 km W Hadim gegen Bozkır, 1640 m, 29.7.1992, *Nydegger 46885* (MSB) - 56 km from Akseki in the Beyşehir direction, meadows, 3.6.1996, *M.*

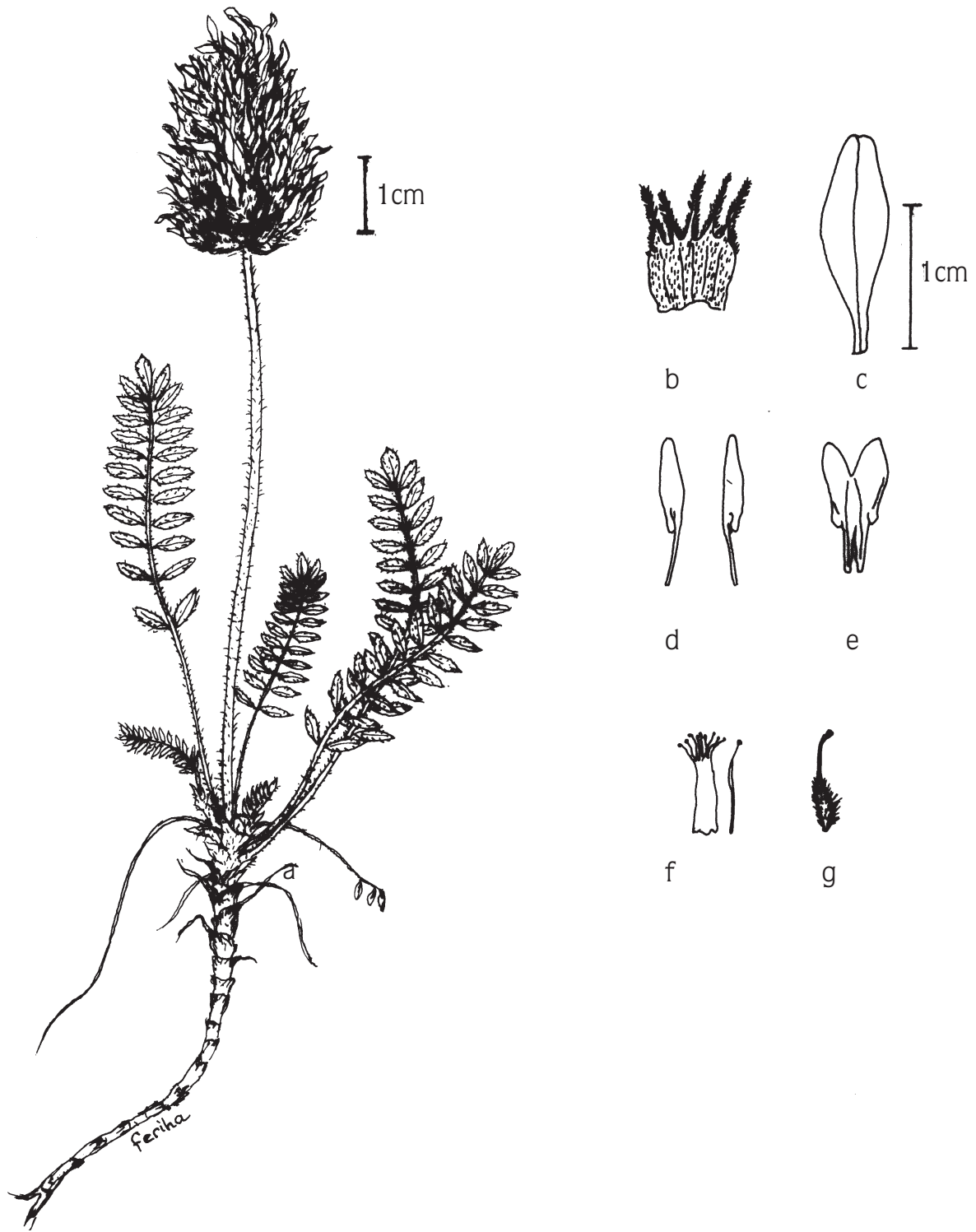


Figure 17. *A. sibthorpianus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

Ekici 1885 & H. Akan (GAZI) - [C4] Antalya: Gazipaşa, around Sugözü village, 1500-1900 m, 22.5.1984, *H. Sümbül 2931* (HUB) - Karaman: 1 km E İhsaniye, zwischen Ermenek und Karaman, 1460 m, 21.5.1993, *Nydegger 47242* (MSB).

Distribution: Endemic. East Mediterranean.

This species is endemic to Turkey and used to be known only from the type locality. We note that the Flora of Turkey maintained that *A. paecilanthus* was distinct from *A. sibthorpianus*. However, we now have a greater range of material available that demonstrates that this distinction can no longer be maintained. We therefore treat the former as a synonym of the latter.

12. *Astragalus stenosemius* Boiss., Diagn. pl. orient., ser. 2, 2: 27. 1856.

≡ *Tragacantha stenosemia* (Boiss.) Kuntze, Revis. Gen. 2: 948. 1891.

Holotype: [Turkey] prope Bakker Maaden (Ardana) Armeniae meridionalis, VI.1852, *F.W. Noë 813* (G-BOIS; iso: WI).

Figure 18,21.

Plants acaulescent, 5-14 cm, covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems almost absent. Stipules membranous, yellowish, in upper part purplish or wholly purple, 9-12 mm, narrowly triangular, adnate to the petiole for 2-4 mm, otherwise free from each other, at the base sparsely to densely adpressed white hairs, towards the apex glabrescent or glabrous, only at the margin and the tip hairy. Leaves 1-6 cm; petiole 0.2-3 cm, densely covered with adpressed short white hairs. Leaflets 4-10-paired, folded or somewhat flat, narrowly elliptic to elliptic, rarely narrowly obovate, acute to very minutely mucronulate at the apex, 4-10 x 1.5-3 mm, on both sides densely covered with adpressed, short, white hairs. Peduncle 2.5-10 cm, scarcely sulcate, covered with white, long spreading hairs that are c. 2 mm long and with short adpressed white hairs. Raceme ovoid to shortly cylindrical, 20-40-flowered, 1.5-4 x 1-1.5 cm, elongating in fruit. Bracts 5-10 mm, narrowly ovate to often keeled, membranous, in lower part yellowish, in upper part purple or sometimes greenish or wholly purple, soon changing to whitish-yellow, ± densely covered with adpressed white hairs. Bracteoles absent. Pedicels 0.5-1 mm, hairy. Calyx greenish-yellow to whitish-yellow, 7-10 mm, tubular,

densely covered with long, spreading white hairs; teeth linear-acute, equal, green, 4-5 mm, on innerside glabrescent to glabrous. Petals purple to crimson. Standard 10-14 x 2 mm, narrowly pandurate-oblong, shallowly constricted at the middle, in lower half slightly wider than in upper half, obtuse to acute at the apex, without differentiated claw. Wings 8-9 mm blades narrowly oblong, acute at the apex, 5-7 x 1-1.5 mm auricle minute, 0.1-0.2 mm, claw 2-3 mm. Keel 5-7 mm, blades obliquely narrowly elliptic, acute at the apex, 4-5 mm, auricle minute, claw 1-2 mm. Stamens 4-5 mm, the upper 1-2 mm free. Ovary shortly stipitate, densely white-hairy; style hairy only at the base. Fruits narrowly ovoid, 6-10 x 3-4 mm, laterally compressed, densely white hairs; beak 1-2 mm, straight. Seeds 2-3 mm, smooth.

Flowering time: 5-7 **Habitat:** Steppe, gypsum places; 1000-1850 m.

Specimens seen:

[A6] Tokat: in planitie Artova supra Tokat, 1300 m, 30.5.1890, *Bornmüller 1694* (B) - Artova, around Sineburnu, *P. sylvestris-Q. pubescens* forest, 1400-1500 m, 24.6.1980, *R. İlarşlan 1127* (ANK) - Sivas: in monte Tschamly-bel, 1400-1500 m, 1.6.1890, *Bornmueller 1637* (K, W) - Gebirge SE von Ulaş, 47 km SE Sivas gegen Malatya, 1600-1700 m, 17.6.1939, *Reese* (B, W) - 12 km S Gürün, 1800 m, 10.6.1973, *Sorger 73-33-45* (W) - 1 km N Ulaş, zwischen Sivas und Gürün, 1450 m, 5.6.1990, *Nydegger 45646* (B) - 20 km from Darende to Gürün, 1300 m, 20.7.1996, *M. Ekici 1922 & H. Akan* (GAZI, MSB) - 31 km from Kangal in the Sincan direction, 1400 m, gypsum places, 20.7.1996, *M. Ekici 1924 & H. Akan* (GAZI) - Ulaş; E of Tecer village, 1500 m, steppe, 19.7.1996, *M. Ekici 1921 & H. Akan* (GAZI) - [B5] 8 km NW Ürgüp, 1000 m, 12.6.1973, *Sorger 73-39-48* (W) - Nevşehir: Topuz mt., zwischen Develi und Ürgüp, 1535 m, 13.6.1983, *Engel 28b* (B) - Göreme; Zelve, 1000 m, 16.5.1997, *M. Ekici 1932* (GAZI) - [B6] Kayseri: W side of pass [Ziyarettepesi pass] between Pınarbaşı and Gürün, 1820 m, 18.6.1954, *Davis 21981* (E, K) - 24 km from Pınarbaşı to Göksun, 500 m, steppe, 18.7.1996, *M. Ekici 1918 & H. Akan* - Pınarbaşı; above waterfall, 1450 m, 7.7.1996, *M. Ekici 947 & H. Akan* - Malatya: 6 km E Darende gegen Hekimhan, 1380 m, 4.6.1987, *Nydegger 62628* (MSB) - Sivas: 69 km from Sivas to Gürün, 1500 m, 14.6.1998, *M. Ekici 2073 & H. Akan* (GAZI, MSB).

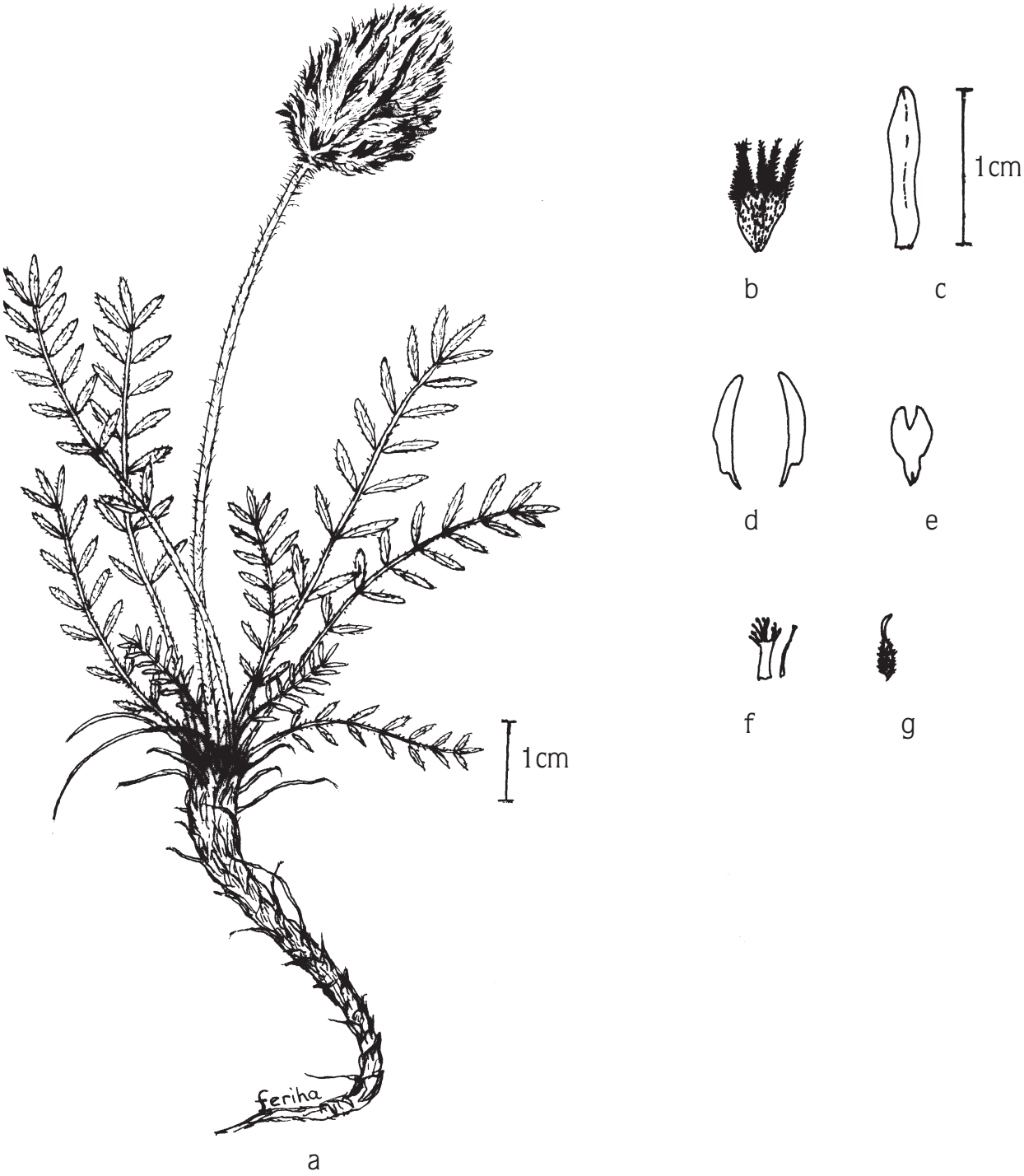


Figure 18. *A. stenosemius*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

Distribution: Endemic. Irano-Turanian element.

This Central Anatolian endemic is very distinct and cannot be confused with any other species.

13. *Astragalus stenosemioides* D.F.Chamb. & V.A.Matthews, Notes Roy. Bot. Gard. Edinburgh 29: 303. 1969.

Holotype: Turkey, B5 Kayseri, Cappadocia, mt. Argaei (Erciyas Da.), 2700-3000 m, 18.6.1890, J.F.N. Bornmüller 1637 (BM; iso: BI, BR, KI, W!).

Figure 19,21.

Plants acaulescent, 2-4(-5) cm, covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems absent. Stipules membranous, green to yellowish-green, 5-10 mm, narrowly triangular to triangular, adnate to the petiole for 2-3 mm, otherwise free from each other, at the margin and apex sparsely adpressed white hairs, otherwise glabrous or sometimes sparsely hairy only at the base. Leaves 1-3 cm; petiole 0.4-1 cm, white-hairy. Leaflets 5-8-paired, folded or somewhat flat, 3-6 x 1-2.5 mm, narrowly elliptic or narrowly obovate to elliptic, acute to obtuse at the apex, white-hairy on both sides. Peduncle 1-3 cm, densely covered in lower part with adpressed white, in upper part with predominantly black hairs. Raceme globose to shortly oblong, 15-25-flowered, 1.5-2 x 1-1.5 cm. Bracts membranous, yellowish-white with greenish tip, narrowly triangular, 5-8 mm, with sparse to dense black and white hairs, soon glabrescent. Bracteoles absent or 2, c. 2 mm, hairy. Calyx yellowish-greenish, 6-7 mm, tubular, densely covered with ± adpressed black and white or sometimes only white hairs; teeth linear, green, 3-4 mm, densely covered with long black (towards the base also white) hairs, on inner surface glabrescent. Petals purplish-pink. Standard 9-12 x 2-3 mm, oblong-pandurate, obtuse to acute at the apex, slightly constricted in the middle, without clearly differentiated claw, only slightly narrowed at the base. Wings 6-8 mm, blades narrowly oblong, acute at the apex, 5-7 x 1-1.5 mm, auricle c. 0.3 mm, claw 1-1.5 mm. Keel 4-5 mm, blades oblong-elliptic, acute at the apex, 3-4 x 1-1.5 mm, auricle minute, c. 0.2 mm, claw 1-1.5 mm. Stamens 3 mm, the upper 1 mm free. Ovary subsessile, white hairy, style hairy only at the base. Fruits unknown.

Flowering time: 5-6. **Habitat:** Steppe, stony places; 2200-3000 m.

Specimens seen:

[B5] Kayseri: mt. Argaei (Erciyas mt.), 2450 m, 18.6.1934, *Balls 1418* (E, K) - *ibid.*, 2300-2400 m, 24.6.1998, *M. Ekici 2104* & *H. Akan* (GAZI, MSB).

Distribution: Endemic. Irano-Turanian element.

This very local endemic grows only on Erciyas mountain in Kayseri Province, though at a low population density. Because of extreme grazing pressure no fruiting specimens have been collected during our 3 years of study. Therefore, the future of this species will remain under threat unless conservation measures are taken.

14. *Astragalus amoenus* Fenzl, Pug. Pl. Nov. Syr.: 4. 1842.

≡ *Tragacantha amoena* (Fenzl) Kuntze, Revis. Gen. 2: 943. 1891.

Lectotype: [Turkey] in alpinus Tauri occid., aestate 1836, *Th. Kotschy 124* (W!; iso: BI, BM, G, G-BOIS, KI, LE, MI, MSBI, OXF, P, W!).

= *A. demissus* Boiss. & Heldr., in Boissier, Diagn. pl. orient., ser. 1, 9: 50. 1849.

Holotype: in monte Gheidagh Tauri Isaurici, 6000', *T.H.H. von Heldreich* (G-BOIS).

= *A. squalidus* Boiss. & Noë, in Boissier, Diagn. pl. orient., ser. 2, 2: 29. 1856 ≡ *Tragacantha squalida* ("Boiss." Boiss. & Noë) Kuntze, Revis. Gen. 2: 948. 1891 ≡ *A. amoenus* Fenzl subsp. *squalidus* (Boiss. & Noë) Ponert, Feddes Repert. 83: 631. 1973.

Holotype: prope Sivas, VI.1842, *Noë 1084* (G-BOIS; iso: BI).

= *A. wettsteinianus* Freyn & Sint., Bull. Herb. Boiss. 3: 183. 1895.

Lectotype (ined., PODLECH): [Turkey] Armenia turcica, Gümüşkhane, in monte Darsosdagh, 6.6.1894, *P.E.E. Sintenis 5735* (BRNM: foto MSBI; iso: BI, BM, BP, BR, EI, G, JE, KI, L: foto KI, MSBI, LE, MI, P, PR, W!).

= *A. squalidus* var. *chloroxanthinus* Freyn & Bornm., Österr. Bot. Z. 42: 48. 1892 ≡ *A. chloroxanthinus* (Freyn & Bornm.) Ponert, Feddes Repert. 83: 631. 1973.

Type: [Turkey] Pontus galaticus, in monte Abadschi-Dagh, 1200-1500 m, 11.5.1890, *J.F.N. Bornmüller 2099* (BI, G).

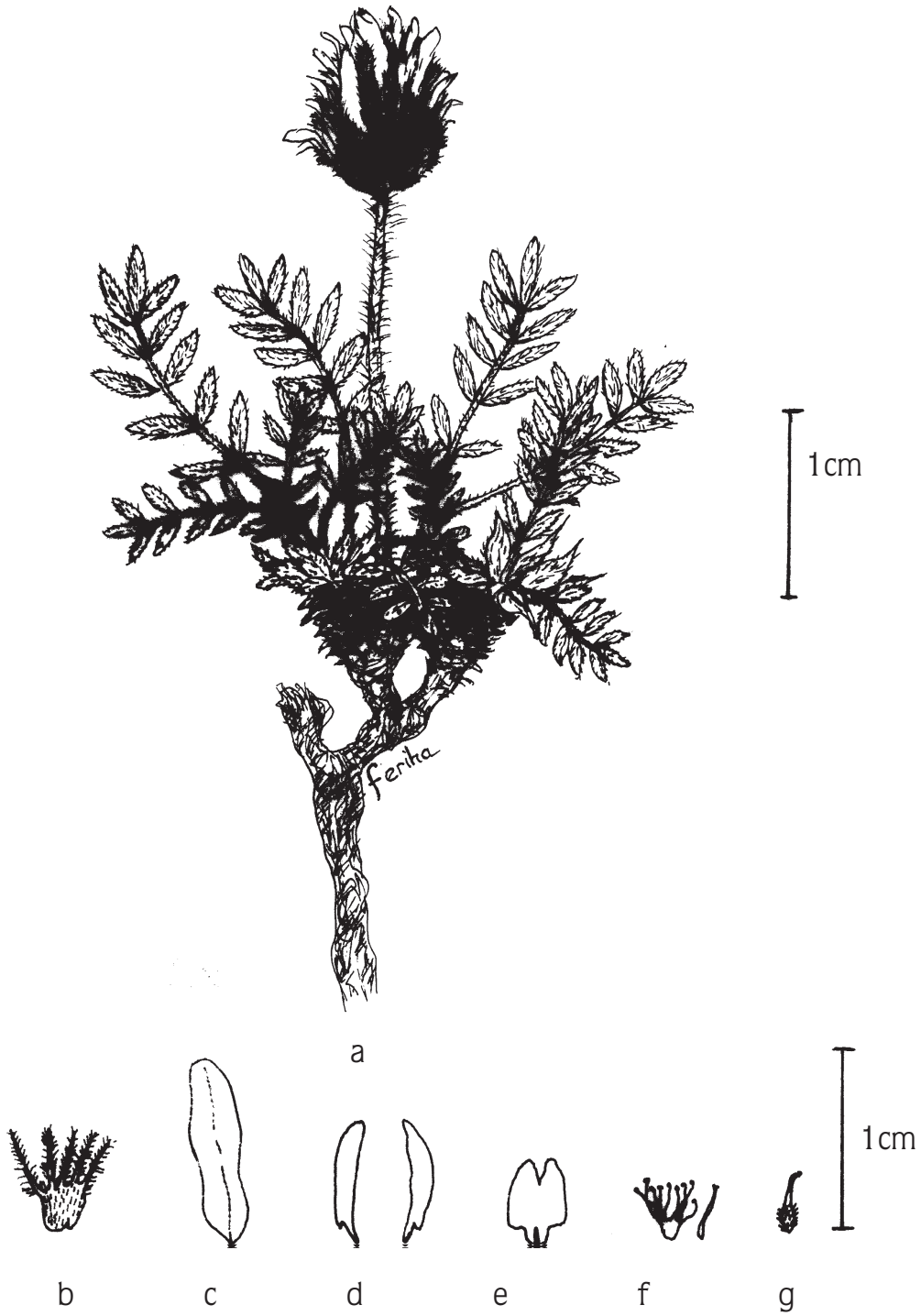


Figure 19. *A. stenosemioides*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

Figure 20.21.

Plants 2-14 cm, acalusecent or shortly caulescent, covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems absent or up to 2 cm, erect, sulcate, densely covered with adpressed white hairs, concealed by the overlapping stipules. Stipules membranous, yellowish or in upper part greenish, brownish when dry, 5-7 mm, ovate to triangular with acute to subulate tip, adnate to the petiole for 2-3 mm, otherwise free from each other, at the margin and apex with sparse white hairs, otherwise glabrous. Leaves 1-5 cm; petiole 0.2-2 cm, densely covered with short, adpressed black and white hairs, soon glabrescent or with only sparse hairs. Leaflets 4-10-paired, flat or folded, narrowly elliptic to narrowly obovate, rarely oblong, acute or minutely mucronulate at the apex, 2-8 x 1-3 mm, on upper surface sparsely hairy to glabrous, on lower surface densely adpressed shortly white-hairy. Peduncle 0.5-8 cm, sulcate, with sparse adpressed black and white hairs. Raceme globose to oblong, 10-20-flowered, 1-2.5 x 1-2 cm, elongating in fruit. Bracts membranous, at the base yellowish, at the tip greenish, narrowly triangular, 2-4 mm, sparsely to densely covered with spreading, predominantly white hairs. Bracteoles absent or only 1, 0.5-1 mm, linear to very narrowly ovate, hairy. Pedicels up to 1.5 mm, hairy. Calyx whitish-yellow, sometimes pale pink-suffused or completely pale pink, 6-9 mm, tubular-campanulate, sparsely covered with spreading predominantly white hairs or sometimes with predominantly black hairs or white hairs on the upper surface and black hairs on the lower surface; teeth subulate, greenish, 2-4 mm, sparsely to densely black and white-hairy, on inner surface sparsely white-hairy. Petals yellow or purple. Standard 12-15(-17) x 4-7 mm, ovate, retuse to emarginate at the apex, without a clearly differentiated claw, at the base widely cuneate. Wings 10-13 mm, blades narrowly oblong, clearly constricted above the auricle, obtuse at the apex, 6-8 x 1-2.5 mm, auricle 1-1.5 mm, claw 4-6 mm. Keel 9-11 mm, acute at the apex, 4-6 x 2-3 mm, auricle c. 0.5 mm, claw as long as the blades. Stamens 5-10 mm, the upper 2-3 mm free. Ovary shortly stipitate, long white hairs; style hairy only at the base. Fruits narrowly ovoid to oblong, 7-10 x 3 mm, laterally compressed, densely covered with white hairs; beak 1-2 mm, curved. Seeds 2-3 mm, dark greenish to brown, smooth.

Flowering time: 5-7. **Habitat:** Steppe, meadows, etc.; 500-3050 m.

Specimens seen:

Turkey [A3] Ankara: Beypazarı; Mahiyetepesi, 30.6.1971, c. 2000 m, *Y. Akman 890* (ANK) - [A4] Ankara: Çamkoru, NW von Kızılcahamam, 1350 m, 4.6.1970, *Bozakman & Fitz 805, 812* (W) - between Kızılcahamam and Çeltikçi, 6.6.1970, *Bozakman & Fitz 904* (W) - 26 km N Kızılcahamam, 1300 m, 14.6.1971, *Sorger 71-3-36* (W) Ayaş pass, c. 1100 m, 1.6.1975, *Y. Akman 6676* (ANK) - 31 km N Kızılcahamam, 1500 m, 16.7.1977 *Sorger 77-51-1* (W) - Bolu: 34 km SE Gerede, 1600 m, 8.6.1962, *Sorger 62-82-15* (W) - Aladağ, between Soku and Kartalkaya, 1380 m, 19.5.1970, *Bozakman & Fitz 590* (W) - Gerede; between Aktaş and Yukarı Ovacık, 18.6.1976, *O. Ketenoğlu 535* (ANK, KNYA) - 1 km S of southern edge of Abant lake, 1430 m, 23.5.1990, *Lampinen 7823* (E) - Kastamonu: between Kastamonu and Küre, 1220 m, 8.6.1954, *Davis 21699* (ANK, E, K) - Tosya; between Ortalıca plateau and Çukurhan village, *P. nigra* forest, c. 1500 m, 13.6.1975, *M. Kılınc 3223* (ANK) - zwischen Çorum und Tosya, gegen Çakırlar, 1580 m, 7.8.1989, *Nydegger 44661* (MSB) - [A5] Çorum: Köse mt., N. of Çorum, 1500 m, 31.5.1965, *Coode & Jones 1899* (E) - [A6] Amasya: in monte Kara-Dagh, 500-700 m, 28.5.1889, *Bornmüller 87* (E) - Samsun: Ladik; Karadağ, 1100 m, 8.5.1965, *Tobey 946* (E) - Sivas: 40 km N of Zara, beyond the pass, 1900 m, 26.6.1969, *Andersen & Petersen 15* (E) - pass N Zara towards Suşehri, 24.5.1970, *Rix et al. 1721a* (E) - 12 km N Sivas, Karaçayır, 1600 m, 27.6.1970, *Sorger 70-18-27* (W) - [B3] Afyon: Bayat; around Kurtlaralanı, 1450 m, 24.4.1975, *M. Vural 114* (KNYA) - [B4] Ankara: bei Ankara, 8.6.1933, *Kotte* (K) - AOÇ, near Dolapdere, 6.1963, *Alinoğlu 158* (E) - Beynam, 55 km SW of Ankara, 1000 m, 12.7.1965, *Ledingham & Ekim 4323* (E) - Beynam forest, 14.5.1971, *Price 562* (K) - ibid., steppe, 1200 m, 18.5.1985, *Z. Aytaç 1900*, *H. Duman* (GAZI) - Dikmen, Çal mt., 1100-1200 m, 5.6.1984, steppe, *M. Vural 2862* (GAZI) - Elmadağ, 10.5.1998, 1500-1600 m, steppe, *M. Ekici 2060* (GAZI) - [C3] Antalya: 28 km N Akseki 1300 m, 29.5.1962, *Sorger 62-59-8* (W) - N. part of Talaz mt., above Çimiköy, 1520 m, 28.5.1991, *Zielinski s.n.* (MSB) - 53 km from Beyşehir in the Akseki direction, 1450 m, 3.6.1996, *M. Ekici 1879 & H. Akan* (GAZI, MSB) - 17 km N Akseki,

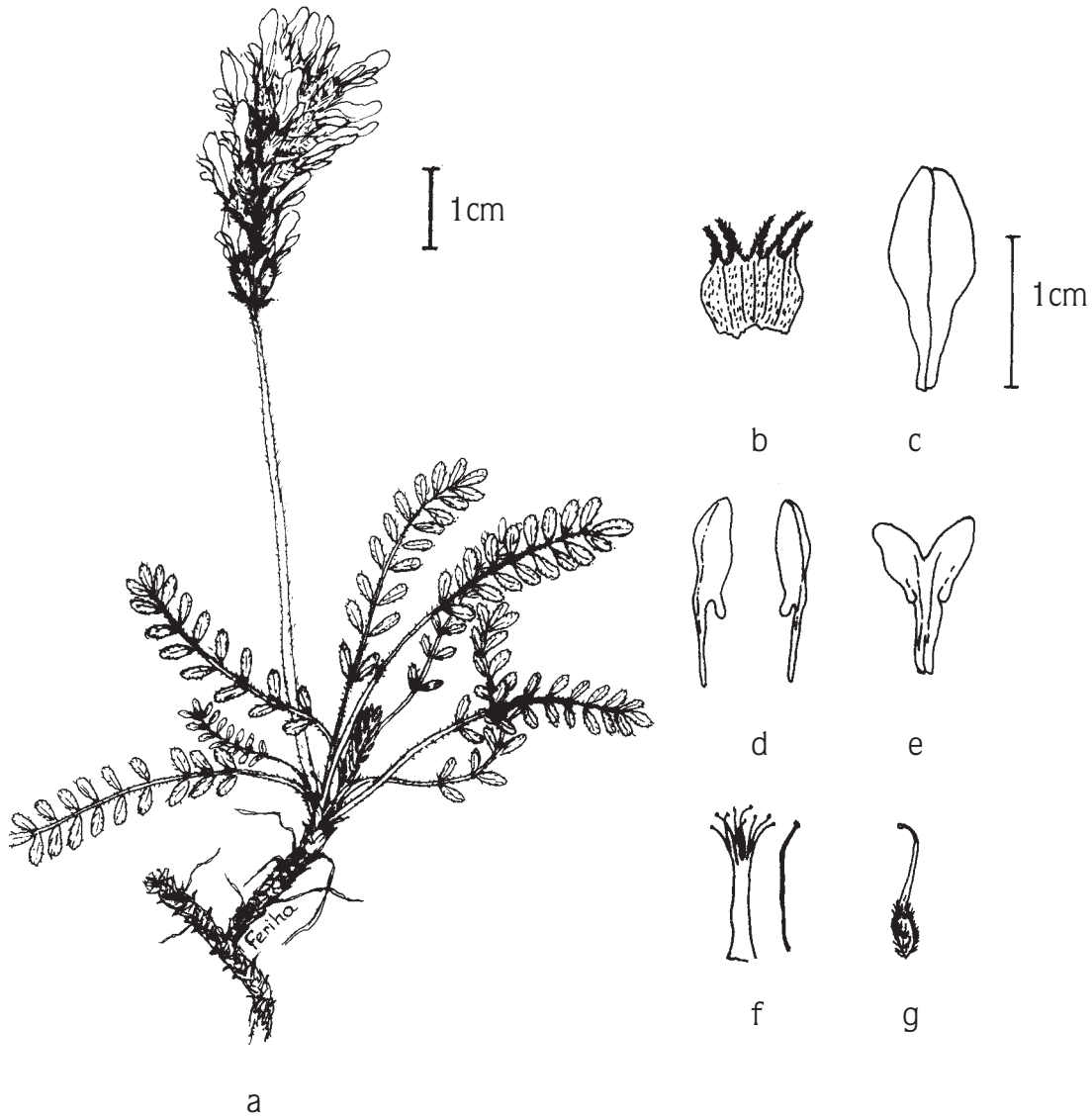


Figure 20. *A. amoenus*. a. habit, b. calyx, c. standard, d. wing, e. keel, f. stamens, g. ovary.

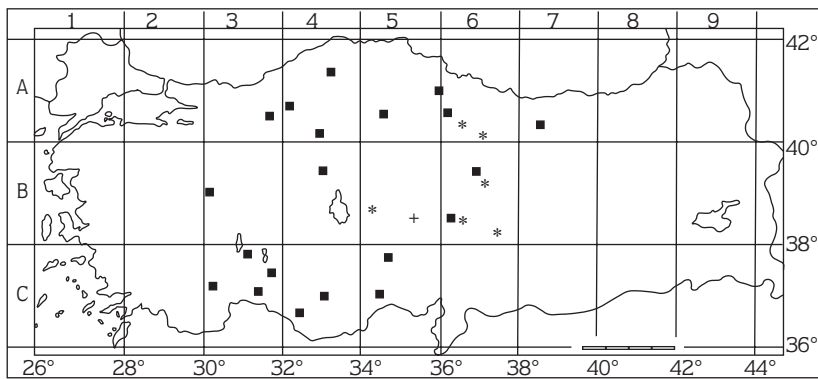


Figure 21. Distribution in Turkey (*) *A. stenosemius*, (+) *A. stenosemioides*, (■) *A. amoenus*.

flowers dirty yellow, drying brown, 5.1997, *Victoor-van Hoe 1704* (MSB) - Isparta: Beyşehir; Bademli village, 1400 m, 22.5.1983, *S. Erik 6041* & *M. Koyuncu* (HUB) - [C4] Antalya: Gazipaşa, Çayırakası plateau, 1750 m, 17.7.1982, *H. Sümbül 1422* (HUB) - Gazipaşa, Çobanlar village, Oyuklu plateau, 1900-2000 m, 11.7.1983, *H. Sümbül 2236* (HUB) - Gazipaşa; Sugözü village, Maha plateau, 1900-2000 m, 17.5.1983, *H. Sümbül 1772* (HUB) - ibid. 22.5.1984, *H. Sümbül 2931* (GAZI) - Karaman: above Koraş village, 1800-1900 m, 23.6.1998, *M. Ekici 2095* & *H. Akan* (GAZI, MSB) - Konya: Seydişehir; Tınaztepe, 1600 m, 4.6.1996, *M. Ekici 1889* & *H. Akan* (GAZI, MSB) - 2 km from Çamlık in the Beyşehir direction, 1450-1700 m, 29.6.1998, *P. nigra* forest, *Z. Aytaç 7836* & *H. Duman* (GAZI) - [C5] Konya: Ereğli, Aydos mt., Yazıgöl plateau, steppe, 2800 m, 10.7.1977, *S. Erik 2336* (HUB, E) - Bolkar mt., NE part, W of summit of Mededsiz, 2500-2600 m, 37°24' N, 34°40' E, 26.7.1984, *Görk, Hartvig & Strid 24011* (MSB, EGE) - Niğde: in jugo Ketsiebele, Dasch-olugh et juxta fodinas Bulgar Magara (Bulgar mt.), 2430-2600 m, 14.7.1853, *Kotschy 61, 107e* (K, MSB, W) - au-dessus de Bulgarmaden, 27.8.1855, *Balansa 476* (K, MSB, W) - Gıyıl deppe, 2850 m, Bugharmaden, 7.1912, *Siehe 559* (E, W) - Ulukışla; Çiftahan, between Karagöl and Çinili lake, stony places, c. 2500-2700 m, 23.8.1990, *Y. Gemici 5818* (EGE).

Distribution: Endemic. Irano-Turanian element

While *A. amoenus* and *A. squalidus* were treated as separate species in the Flora of Turkey, the similarity between them was also noted.

Diagnostic features that were used to distinguish between them, such as leaf and leaflet sizes, types of calyx hairs and corolla colour, have proved to be unreliable. Our examination of herbarium samples and material collected in the field has shown that the leaflets of *A. amoenus* can be over 5 cm long, the leaflets up to 8 mm long, and up to 10-paired. Furthermore, the leaves of *A. squalidus* can be less than 5 cm long. Moreover the proportion of black to white hairs on the flowers is not constant, and the corolla can vary from violet to yellow, even in the same specimen. It is also noted that the Flora of Turkey cited 2 specimens (Coode & Jones 2723 & Watson et al. 2580) as being intermediate between the 2 species. For these reasons *A. squalidus* is here treated as a synonym of *A. amoenus*.

Excluded Species

A. ocakverdii Kit Tan & Sorger in Pl. Syst. Evol. 154: 115 (1986); see also Flora of Turkey vol. 10 (Supplement): 120. 1988.

Holotype: Turkey, C4 Konya, Seydişehir, Tınaz Dağı, *Pinus nigra* forest, ca. 1600 m, 11 vi 1981, *H. Ocakverdi 1348* (holo. Hb. Selcuk Univ. Konya!, iso. E!).

This was originally described as a new species in the section *Hololeuce*. However, we have studied the type specimen and consider that it is synonymous with *A. acmonotrichus* in the section *Synochreati*. This name should therefore be deleted from the list of species in the section *Hololeuce*.

Conclusions

From our morphological and palynological studies on a wide range of herbarium material from a number of herbaria and from material collected in the wild we have come to the following conclusions.

We reduce 5 of the species recognised in the section *Hololeuce* before this study to synonyms. *A. vuralii* is treated as a synonym of *A. andrasovszkyi*, *A. cylindraceus* a synonym of *A. globosus*, *A. alindanus* a synonym of *A. hirsutus*, *A. paecilanthus* a synonym of *A. sibthorpianus* and *A. squalidus* a synonym of *A. amoenus*.

A. karputanus is reduced to the rank of subspecies under *A. bicolor*. Furthermore the range of *A. bicolor*, treated as a Turkish endemic in the Flora of Turkey, is here extended to include Iran.

The recently described *A. dumanii* from Goksun, Berit mt., a new member of the section *Hololeuce*, is also noted.

Before this study there were 20 species recognised in this section; the number has now decreased to 15.

The uniformity of the structure of the pollen of the species of the section *Hololeuce* is demonstrated by the palynological studies carried out, and is in line with that of almost all of the other species of *Astragalus*. However, there are small differences in the pollen shapes of some of the species, as can be seen from the measurements given in Table 2.

This study has shown that there is a close morphological similarity between the species in the sections *Onobrychium* and *Hololeuce*. The diagnostic

Table 2. Morphological pollen measurements and averages of *Hololeuce* section members.

Species	P	E	P/E	Clg	Clt	Plg	Plt	Plg/Plt	Exine	Intine
<i>A. incertus</i>	31.73 ± 1.68	28.26 ± 1.59	1.12	26.52 ± 0.96	6.05 ± 0.83	7.82 ± 0.95	8.69 ± 1.06	0.89	1.30 ± 0.64	0.68 ± 0.43
<i>A. hyalolepis</i>	23.21 ± 1.11	17.57 ± 1.55	1.32	18.57 ± 1.09	5.35 ± 0.75	5.71 ± 1.08	6.07 ± 0.66	0.94	1.14 ± 0.75	0.53 ± 0.21
<i>A. bicolor</i> subsp. <i>bicolor</i>	22.18 ± 1.33	17.18 ± 0.98	1.29	16.56 ± 0.98	5.01 ± 0.77	5.01 ± 0.77	5.31 ± 0.67	0.94	1.08 ± 0.71	0.50 ± 0.19
<i>A. bicolor</i> subsp. <i>karpitanus</i>	21.42 ± 1.51	17.57 ± 1.03	1.32	18.57 ± 0.87	5.71 ± 1.02	5.71 ± 1.02	6.07 ± 0.73	0.94	1.14 ± 0.75	0.53 ± 0.21
<i>A. caudiculosus</i>	23.70 ± 1.67	17.13 ± 1.77	1.38	16.97 ± 1.45	5.27 ± 0.63	5.27 ± 0.63	5.79 ± 0.99	0.91	1.13 ± 0.55	0.51 ± 0.22
<i>A. andrasovszkyi</i>	30.07 ± 1.98	19.65 ± 2.03	1.53	21.88 ± 1.89	6.27 ± 0.66	6.27 ± 0.66	6.74 ± 1.22	0.93	1.30 ± 0.66	0.65 ± 0.28
<i>A. alyssoides</i>	29.50 ± 1.88	21.63 ± 2.09	1.36	24.13 ± 1.11	6.78 ± 0.76	6.78 ± 0.76	7.61 ± 1.01	0.89	1.27 ± 0.45	0.63 ± 0.41
<i>A. hirsutus</i>	29.60 ± 1.68	20.40 ± 1.58	1.45	24.05 ± 1.59	6.13 ± 0.55	6.13 ± 0.55	7.03 ± 1.23	0.87	1.23 ± 0.54	0.64 ± 0.38
<i>A. cataonicus</i>	32.49 ± 1.79	20.05 ± 1.89	1.62	25.13 ± 2.11	7.03 ± 0.85	7.03 ± 0.85	7.92 ± 0.91	0.89	1.30 ± 0.68	0.65 ± 0.33
<i>A. dumanii</i>	32.93 ± 1.68	25.86 ± 1.50	1.50	26.06 ± 1.39	7.13 ± 0.98	7.13 ± 0.98	7.83 ± 1.13	0.91	1.27 ± 0.63	0.68 ± 0.29
<i>A. globosus</i>	29.35 ± 2.08	22.92 ± 2.15	1.28	22.85 ± 1.97	7.11 ± 0.86	7.11 ± 0.86	8.07 ± 0.66	0.88	1.27 ± 0.56	0.65 ± 0.23
<i>A. sibthorpianus</i>	28.73 ± 1.65	19.51 ± 1.43	1.47	22.75 ± 1.13	6.05 ± 1.01	6.05 ± 1.01	6.98 ± 1.13	0.86	1.23 ± 0.55	0.59 ± 0.21
<i>A. stenosemius</i>	27.25 ± 2.13	19.21 ± 2.35	1.41	21.03 ± 1.99	5.97 ± 0.63	5.97 ± 0.63	6.83 ± 0.65	0.87	1.20 ± 0.59	0.61 ± 0.24
<i>A. stenosemioides</i>	27.83 ± 2.55	20.02 ± 2.78	1.39	21.87 ± 2.09	6.03 ± 0.54	6.03 ± 0.54	6.85 ± 1.09	0.88	1.21 ± 0.56	0.65 ± 0.23
<i>A. amoenus</i>	28.50 ± 1.54	20.09 ± 1.33	1.41	23.25 ± 0.98	6.35 ± 1.03	6.35 ± 1.03	7.05 ± 1.05	0.90	1.25 ± 0.61	0.63 ± 0.19

differences between these 2 sections should become clearer once studies on the section *Onobrychium* are complete. The taxonomic distinctions between the species in the section *Hololeuce* are more or less clarified by this study. However, the importance of parallel studies on the section *Onobrychium* is now indicated.

Both the sections *Hololeuce* and *Onobrychium* may have originated in the Caucasus, though they are now distributed across Central Asia and Anatolia. Neither is represented in Siberia, Western Russia or on the steppes of Europe. Probably, the more advanced species have evolved from members of the section *Onobrychium* in the Anatolian-Caucasian region. Cladistic studies on the 2

sections might help us to define the boundaries between them.

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