

Astragalus austrobalcanicus, a new species of *Astragalus* sect. *Caprini* from southern Albania and northern Greece

CLEMENS MAYLANDT^{1,2,4}, PHILIPP KIRSCHNER^{1,5}, BOŽO FRAJMAN^{1,6}, PAU CARNICERO^{1,3,7} & PETER SCHÖNSWETTER^{1,8*}

¹Department of Botany, University of Innsbruck, Sternwartestr. 15, 6020 Innsbruck, Austria

²Institute of Botany, Department of Ecosystem Management, Climate and Biodiversity, BOKU University, Gregor-Mendel-Straße 33, 1180 Vienna, Austria

³Department of Animal Biology, Plant Biology and Ecology, Autonomous University of Barcelona, Bellaterra, Spain

⁴✉ maylandt.c@gmail.com;  <https://orcid.org/0000-0001-9363-1474>

⁵✉ philipp.kirschner@gmail.com;  <https://orcid.org/0000-0002-9263-5112>

⁶✉ bozo.frajman@uibk.ac.at;  <https://orcid.org/0000-0002-3667-1135>

⁷✉ pau.carnicero@gmail.com;  <https://orcid.org/0000-0002-8345-3309>

⁸✉ peter.schoenswetter@uibk.ac.at;  <https://orcid.org/0000-0001-9225-4566>

*Author for correspondence: ✉ peter.schoenswetter@uibk.ac.at

Abstract

Astragalus sect. *Caprini* includes 300 species occurring in dry habitats from lowlands to the alpine belt from northwestern Africa and western Europe in the West to Central Asia in the East. In Europe, approximately a dozen taxa occur and our recent phylogenomic study (Maylandt *et al.*, 2025) revealed a genetically divergent lineage from the mountains of southern Albania and northern Greece that was traditionally treated as *Astragalus exscapus*, *A. pubiflorus* or *A. exscapus* subsp. *pubiflorus*. Here, based on an extended sampling for morphometric analysis we show that this lineage is morphologically distinct and differs from closely related, proximally occurring and/or morphologically similar *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus*. Therefore, we here describe this lineage as a new species, *Astragalus austrobalcanicus*, and provide diagnosis, description, geographical distribution, and conservation status as well as a table with diagnostic characters differentiating it from its closest relatives. In addition, we established the chromosome number $2n = 16$ for this new species.

Key words: Leguminosae, *Astragalus*, *Caprini*, Albania, Greece, Balkan

Introduction

Within the hyper-diverse milkvetch genus *Astragalus* Linné (1753: 755), *Astragalus* sect. *Caprini* De Candolle (1825: 301) forms an early-diverging monophyletic clade (Azani *et al.*, 2019, 2017; Kazemi *et al.*, 2009; Kazempour Osaloo *et al.*, 2005, 2003; Su *et al.*, 2021), which is characterized by basifixed hairs, thickly textured legumes and relatively large yellow flowers arranged in typically few-flowered and short-stalked inflorescences (Podlech, 1999, 1988; Podlech & Zarre, 2013; Maylandt *et al.*, 2025). This taxonomically challenging group (Podlech, 1999; Riahi *et al.*, 2011) comprises ca. 300 diploid species (Podlech, 1986, 1988; Martin *et al.*, 2008; Sytin, 2009), that inhabit arid habitats ranging from lowlands up to the subalpine and alpine belt; their distribution extends from northwestern Africa and western Europe to Central Asia. In Europe, *A.* sect. *Caprini* is represented by—depending on taxonomic treatment—approximately a dozen taxa, which are morphologically differentiated based on characters related to floral and legume traits, hairiness of petals and leaflets, or length of the peduncle (Podlech, 1988; Podlech & Zarre, 2013).

Our phylogenomic study focused on the European members of the section (Maylandt *et al.*, 2025) has shown that *A.* sect. *Caprini* originated in the Irano-Turanian region, which is in line with the findings of previous studies on the genus *Astragalus* (Folk *et al.*, 2024ab; Maassoumi & Ashouri, 2022), and started to diversify shortly after the Mid-Pleistocene-Transition ca. 0.5 to 0.7 Ma. The lineages occurring in the southern European mountain ranges characterized by submediterranean climate and vegetation diverged early, while lineages occurring in northern lowland

steppes are younger (ca. 0.2 to 0.3 Ma), emphasizing the importance of southern European mountain ranges as long-term refugia (Maylandt *et al.*, 2025). Based on phylogenetic (RAD, ITS and plastid *ycf1* sequences) and morphometric data sampled from populations distributed in northwestern Africa and Europe, ten lineages were identified, which merit recognition as independent species. While nine of them corresponded to taxonomic entities, for which species names were available, we referred to the tenth lineage as “*A. pubiflorus* Balkan”. This entity with scattered distribution in the mountains of Albania and northwestern Greece was previously treated as *A. exscapus* L. (1771: 275; Barina *et al.*, 2017; Tutin *et al.*, 1968), *A. exscapus* subsp. *pubiflorus* (DC.) Soó (1966: 355; Podlech, 1988; Strid & Tan, 1997; Podlech & Zarre, 2013; Pils, 2016; Strid, 2024) or *A. pubiflorus* De Candolle (1802: 216; Qosja *et al.*, 1992). *Astragalus pubiflorus* s. str. (“*A. pubiflorus* Pontic” in Maylandt *et al.*, 2025) is widespread in steppes of the Pontic Plains north of the Black Sea. Plastid DNA sequences and genomic SNP data indicated clear divergence between both entities and even rejected a sister relationship. Instead, “*A. pubiflorus* Balkan” is sister to a clade composed of *A. dasyanthus* Pallas (1776: 749), *A. exscapus*, *A. pubiflorus* s. str. and *A. transsilvanicus* Schur (1876: 184); within this clade, *A. pubiflorus* s.str. is sister to *A. transsilvanicus*. These results obviously render *A. pubiflorus* in the traditional circumscription polyphyletic. The type locality of *A. pubiflorus* lies within the range of *A. pubiflorus* s. str., therefore the name should be exclusively applied to the Pontic—and not the Balkan—populations (Maylandt *et al.*, 2025; De Candolle, 1802).

In our previous study (Maylandt *et al.*, 2025), limited sampling of individuals to perform extensive morphometric analyses prevented drawing taxonomic conclusions. Here, we supplement the morphometric data set with newly collected specimens in order to further test the morphological divergence between “*A. pubiflorus* Balkan” on the one hand and closely related, proximally occurring and/or morphologically similar *A. exscapus*, *A. hellenicus* Boissier (1872: 292), *A. pubiflorus* and *A. transsilvanicus* on the other hand. For simplicity and in anticipation of our findings—which made the description as a new species necessary—we refer to “*A. pubiflorus* Balkan” as *A. austrobalcanicus* hereafter and describe it as a new species below.

Material and methods

Investigated species and collection of plant material

Taxonomy follows our previous study (Maylandt *et al.*, 2025), where a comprehensive taxonomic-nomenclatural account and an identification key are provided. The data set of Maylandt *et al.* (2025) was pruned to include only *A. austrobalcanicus* and closely related, morphologically similar or geographically close *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus*. Although closely related, *A. dasyanthus* was not included here, because it represents the morphologically most divergent species within the European members of *A. sect. Caprini* due to its caulescent habit (Maylandt *et al.*, 2025). This data set was supplemented by newly sampled herbarium specimens collected in 2024 in the following sites (Fig. 1, Table 1): Population 1, Ostrovicë mountain range (Albania, Korçë, N 40.579137, E 20.47462); Population 2, Gramos mountain range (Greece, Epirus N 40.299247, E 20.799005); Population 3, Voio mountain range (Greece, Epirus, N 40.209259, E 21.082036). Only one shoot per sampled individual was collected from branched individuals to avoid threatening the individual’s survival. Collected specimens were pressed for morphometric analysis and flowers were preserved in 70% alcohol. For the evaluation of the conservation status according to the IUCN criteria v. 3.1. (IUCN, 2012), the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) were calculated with Google Earth v. 7.3.6.9796.

Morphological analyses

Morphological differentiation was investigated across 100 individuals from the following species: *A. austrobalcanicus* (n = 36), *A. exscapus* (n = 32), *A. hellenicus* (n = 16), *A. pubiflorus* (n = 6), and *A. transsilvanicus* (n = 10), (Table 1). We chose to measure a similar set of characters as in Maylandt *et al.* (2025) as they have proven to discriminate between *A. austrobalcanicus* and its next relatives. Altogether, 14 morphological characters were measured with a caliper on the herbarium vouchers (Table 2): bract length in mm (1), calyx length in mm (2), calyx teeth length in mm (3), calyx width in mm (4), leaf length in mm (5), length of a middle leaflet in mm (6), width of a middle leaflet in mm (7), number of leaflet pairs per leaf (8), pedicel length in mm (9), peduncle length in mm (10), petiolule length in mm (11), standard length in mm (12), and stipule length in mm (13). Further, the number of hairs on the entire abaxial surface of the standard was determined (14, also shown as binary character [absent/present] in Fig. 2). Finally, a ratio (15) was calculated from characters (6) and (7) for the principal component analysis (PCA), replacing the original measurements. Each value typically represents the mean of three measurements scored on fully developed organs.

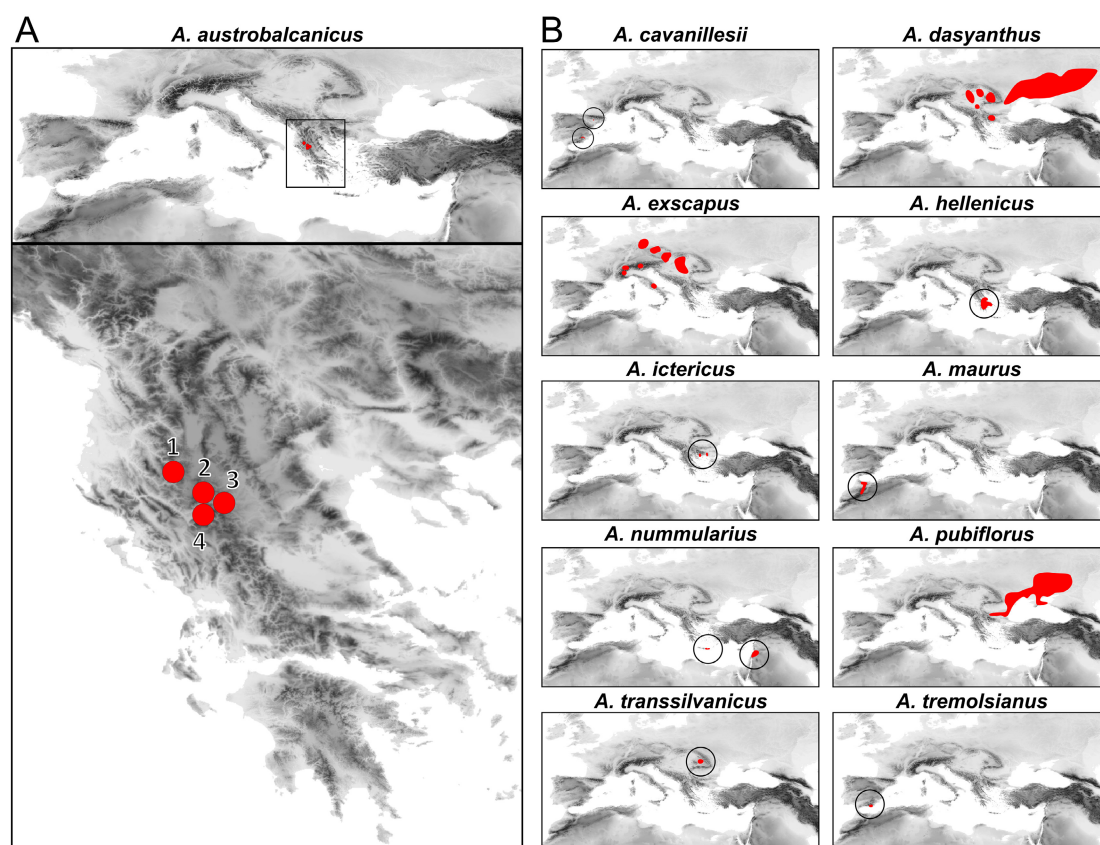


FIGURE 1. A, distribution and investigated populations of *A. austrobalcanicus*. The upper pannel shows the position of the study area in Europe. The occurrence at locality 4 (from Strid, 2024) could not be confirmed in 2024. B, revised distribution ranges of the European and Northwestern African relatives of *A. austrobalcanicus*, based on the findings of Maylandt *et al.* (2025). The maps are based on data from GBIF, iNaturalist, herbarium specimens (Table1) and observations by the authors. For completeness, *A. ictericus* is also indicated here, although it was not included in Maylandt *et al.*, (2025). As some of the species are very narrowly distributed, black circles were added to aid legibility. The map was produced with QGIS 3.22.3 using the gtopo30 basemap, available from: <https://www.usgs.gov/centers/eros/science/usgs-eros-archive-digital-elevation-global-30-arc-second-elevation-gtopo30>)

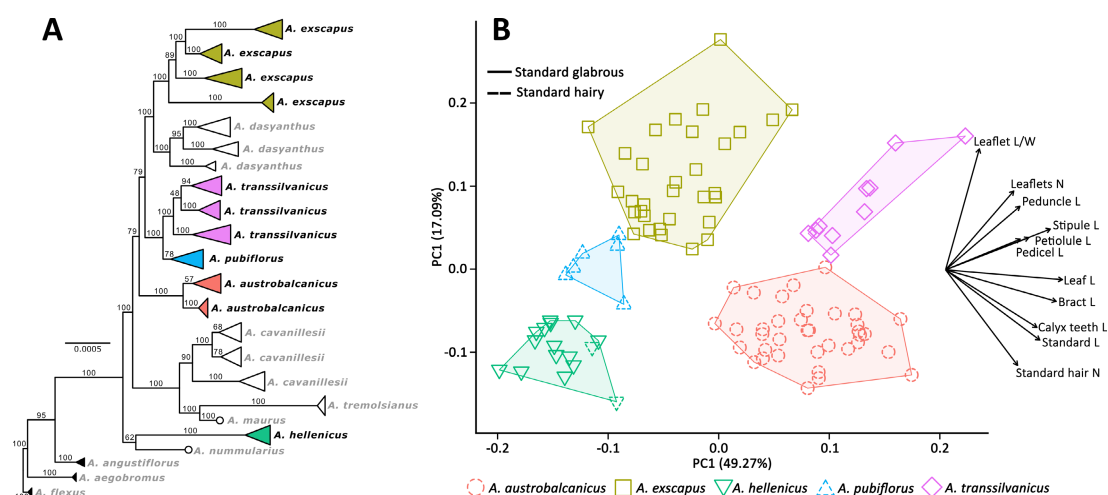


FIGURE 2. A, RAxML-tree based on RADseq data (modified from Maylandt *et al.*, 2025). Taxa included in this study follow the color code in B and taxa which are not part of the present study are in grey. B, morphometric differentiation among *A. austrobalcanicus*, *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus* as illustrated by a principal component analysis based on eleven uncorrelated characters. The scatterplot shows the position of studied samples in the reduced ordination space defined by the principal components 1 and 2. The arrows indicate the impact of the studied morphological characters on the distribution of the samples in the ordination space. The letters L, N, and W stand for length, number and width, respectively. Individuals with hairy standards are represented by symbols with broken outlines.

Correlation among measured characters was tested by Pearson and Spearman correlation coefficients, depending on the distribution of values. To test if character states differed significantly between taxa, we conducted an ANOVA followed by a Tukey's test. Boxplots were produced with the R package ggplot2 using R 4.1.2 (R Core Team, 2021; Wickham *et al.*, 2016). A PCA of standardized variables was conducted with the function prcomp and visualized as a scatter plot using ggplot2 (Wickham *et al.*, 2016).

TABLE 1. Examined herbarium vouchers.

Herb_ID	Taxon	Date	Collector	Country	Region	Locality	Elevation m	Latitude	Longitude
B100187706	<i>A. hellenicus</i>	13.06.1991	Willing	Greece	Central Greece	Fokidos, Parnassidhos, Parnassos, NW Ag. Triada. Trockener Tannenwald, Ka. Alt.: 1150 m	1150	38.516622	22.516704
B100398644	<i>A. hellenicus</i>	29.05.2010	Willing	Greece	Peloponnese	Korinthia, SO Sarandapicho, Kiefern-Tannenwald	1300	38.034397	22.399192
B100398645	<i>A. hellenicus</i>	29.05.2010	Willing	Greece	Peloponnese	Korinthia, SO Sarandapicho, Kiefern-Tannenwald	1300	38.034397	22.399192
B100592448	<i>A. exscapus</i>	06.06.1948	Berger-Landefeldt	Germany	Kyffhäuser	Kyffhäuser, Südwestseite, Ochsenburg bei Steinthaleben. Südhänge, Wiesensteppe. Alt.: 280 m	280	51.375088	11.040435
B100597949	<i>A. exscapus</i>	20.05.1950	Berger-Landefeldt	Germany	Unstruttal	Unstruttal, Steinklöße bei Klein-Wangen westlich Nibra. Offene Grasflur: Caricetum humilis stipetum capillatae auf Bundsandstein. Alt.: 200 m	185	51.277622	11.543856
B100646657	<i>A. exscapus</i>	21.05.1967	Sojak	Czech Republic	Bohemia	Bohemia boreo-occidentalis, colles: České Středohoří, distr. Louny: in declivi occidentali stepposa collis Oblik prope vicum Raná. Alt.: 400 m	375	50.405668	13.77049
B100656269	<i>A. exscapus</i>	28.05.1930	Dragounová	Czech Republic	Bohemia	Bohemia occidentalis-sept.: Lounské Středohoří, in pratis stepposis in jugo collis Raná supra Lenešice prope oppidum Louny. Solo basaltico. Alt.: 400 m	400	50.410315	13.809014
B100705563	<i>A. exscapus</i>	25.05.2016	Hand	Germany	Saxony Anhalt	Sachsen-Anhalt, Weischütz bei Freyburg, Fuß des Nüssenbergs, unweit Beginn des aufsteigenden Pfads, Magerrasen, 178 m	178	51.227547	11.709069
B101013875	<i>A. hellenicus</i>	##.05.1895	Heldreich	Greece	Parnethis	Attica: in regione abietina m. Parnethis, alt. 3500'-4500'	1100	38.16064	23.70633
B101013876	<i>A. hellenicus</i>	13.06.1991	Willing	Greece	Central Greece	Fokidos, Parnassidhos, Parnassos, NW Ag. Triada. Trockener Tannenwald, Ka. Alt.: 1150 m	1150	38.516622	22.516704
B101013877	<i>A. hellenicus</i>	13.06.1991	Willing	Greece	Central Greece	Fokidos, Parnassidhos, Parnassos, NW Ag. Triada. Trockener Tannenwald, Ka. Alt.: 1150 m	1150	38.516622	22.516704

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TABLE 1. (Continued)

Herb_ID	Taxon	Date	Collector	Country	Region	Locality	Elevation m	Latitude	Longitude
B101013879	<i>A. hellenicus</i>	25.06.1982	Hagemann, Scholz, Schwarz	Greece	Central Greece	Stereia Ellas, prov. Fokis, Giona-Massiv, Berge Liritsa und Koromilia, 1800–2000 m, beweidete Felstriften, durchsetzt mit Blockhalden im oberen Bereich in Kalkfelswände übergehend	1800-2000	38.657166	22.318759
B101059087	<i>A. hellenicus</i>	02.05.2018	Willing	Greece	Peloponnese	Korinthia, S Evrostina, Kiefernwald, terrassiert, 1309 m	1309	38.035992	22.398544
B101059088	<i>A. hellenicus</i>	02.05.2018	Willing	Greece	Peloponnese	Korinthia, S Evrostina, Kiefernwald, terrassiert, 1309 m	1309	38.035992	22.398544
B101097566	<i>A. exscapus</i>	17.05.1868	Preussing	Germany	Saxony Anhalt	Rothenburg an der Saale	100	51.65439	11.755973
B101097567	<i>A. exscapus</i>	02.06.1857	Leresche	Switzerland	Valais	Endroit rocailleux dans le bois de Meilezeen montant de Brieg a Berisal, route de simplon (Piton du Valais). Alt.: 3500f	3500	46.295368	8.030568
B101097568	<i>A. exscapus</i>	##.06.1886	Borbas	Hungary	Budapest	Sandy meadow near Pest	100	47.464374	19.075663
B101097570	<i>A. exscapus</i>	21.05.1901	Degen	Hungary	Budapest	Comit. Pest. In monte Somlo prope Feth	400	47.147733	17.371497
B101097571	<i>A. exscapus</i>	31.05.1967	Bäßler, Köhler, Quasdorf	Hungary	Budapest	Sandy hills exiting Dunaharaszti near Budapest	110	47.365907	19.121915
B101097573	<i>A. exscapus</i>	01.07.1914	Bornmüller	Switzerland	Valais	Wallis: Zermatt, im Nikolai- Tale. Alt.: 1600 m	1600	46.026621	7.747
B101097575	<i>A. exscapus</i>	28.05.1883	Hippe	Czech Republic	Ústí nad Labem	Häufig am [...] bei Leitmeritz	300	50.529649	14.093584
B101097576	<i>A. exscapus</i>	##.05.1920	Bernau	Germany	Saxony Anhalt	Zwischen Rotenburg an der Saale und Könnern	100	51.65439	11.755973
B101097577	<i>A. exscapus</i>	12.05.1957	Berger	Switzerland	Valais	Pfyn, (Suisse, canton du Valais), Bois de Finges entre Millien et le P.540,	1450	46.278508	7.859538
B101097578	<i>A. exscapus</i>	20.05.1900	Kappel	Germany	Thuringia	Kyffhäuser, Frankenhausen	180	51.372667	11.04315
B101097584	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
B101097587	<i>A. exscapus</i>	01.08.1893	Winter	Switzerland	Valais	Wallis, Saastal bei ...	1500	46.173175	7.912737
B101097589	<i>A. transsilvanicus</i>	1877	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 200–250 m, Locus Classicus	250	46.071602	24.188922
B101097591	<i>A. exscapus</i>	11.02.1905	Biner	Switzerland	Valais	Wallis, [Heubalm]	1400	46.533768	8.356665

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TABLE 1. (Continued)

Herb_ID	Taxon	Date	Collector	Country	Region	Locality	Elevation m	Latitude	Longitude
B101097594	<i>A. exscapus</i>	02.06.1857	Leresche	Switzerland	Valais	Endroit rocailleux dans le bois de Meilezeen montant de Brieg a Berisal, route de simplon (Piton du Valais). Alt.: 3500	3500f	46.295368	8.030568
B101097596	<i>A. exscapus</i>	07.06.1880	NA	Switzerland	Valais	Clairières du bois de Finges (Valais)	1100	46.324477	7.644072
B101097598	<i>A. transsilvanicus</i>	05.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	300	46.071602	24.188922
G00421081	<i>A. exscapus</i>	01.06.1924	Sirjaev	Czech Republic	Hustopeče	Hustopeče, Pouzďanské, 200-300 m	200-300	48.941676	16.642736
G00421082	<i>A. exscapus</i>	20.05.1932	Weber	Czech Republic	Hustopeče	Hustopeče, Pouzďanské, 200-300 m	200-300	48.941676	16.642736
G00421084	<i>A. exscapus</i>	21.07.1925	Braun-Blanquet	Switzerland	Vinschgau	Above Agums, towards Glurns, 950 m	1350	46.679039	10.587431
G00421086	<i>A. exscapus</i>	19.06.1926	Romieux	Switzerland	Valais	Valais, between Ihalden and Bergli	1800	46.3226951	7.92323788
G00421088	<i>A. pubiflorus</i>	25.06.1968	Vitalariu	Romania	Vaslui	Vaslui, Crasna, near the village Minjesti, 120 m	120	46.600771	27.834305
G00421089	<i>A. austrobalcanicus</i>	28.06.2004	Strid & Vassiliades	Greece	Epirus	Konitsis, Gramos, 4 km WSW of Aetomilitsa, 1500-1600 m	1550	40.299559	20.798918
G00421090	<i>A. transsilvanicus</i>	05.05.1930	Nyarady	Romania	Turda	Transylvania, distr. Turda, near Viisoara, 350 m	350	46.550079	23.927487
G00421092	<i>A. hellenicus</i>	04.06.1995	Strasser	Greece	Peloponnese	Peloponnes, Menalon mountains, 1700 m	1700	37.646564	22.274489
G00421093	<i>A. hellenicus</i>	16.06.1988	Strid & al.	Greece	Attica	Parnethis, Near Ag. Triada. Open Abies cephalonica forest	1050	38.166573	23.699943
IB114742	<i>A. austrobalcanicus</i>	01.06.2024	C. Maylandt & J. Würtl	Greece	Epiros	S ridge of the Mt Voio along the path N of the street Eptachori—Pentalofos	1350	40.209259	21.082036
IB114743	<i>A. austrobalcanicus</i>	01.06.2024	C. Maylandt & J. Würtl	Greece	Epiros	Gramos mountains, 5 km W of the village Aetomilitsa	1550	40.299247	20.799005
IB114744	<i>A. austrobalcanicus</i>	02.06.2024	C. Maylandt & J. Würtl	Albania	Korce	Ostrovicë mountain range, 1.2 km NW of the village Marjan	1500	40.579137	20.47462
IB28413	<i>A. exscapus</i>	##.07.1926	Handel-Mazzetti	Italy	Vinschgau	Vinschgau, Südhang des Schlosshügels von Matsch	1350	46.679397	10.587448
IB28414	<i>A. exscapus</i>	05.07.1927	Handel-Mazzetti	Italy	Vinschgau	Vinschgau, Ober Talatsch am Eingange Schlanders Nonntal, 1400 m	1400	46.648383	10.771217

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TABLE 1. (Continued)

Herb_ID	Taxon	Date	Collector	Country	Region	Locality	Elevation m	Latitude	Longitude
IB34599	<i>A. exscapus</i>	06.07.1926	illegible	Italy	Vinschgau	Vinschgau, auf trockenem Weideboden unter Mutterschnig wz. Mals und Matsch, Im sandigen Lärchenwalde unter den Burgruinen von Matsch	1350	46.679397	10.587448
IB86437	<i>A. exscapus</i>	##.06.1924	Sirjaev	Czech Republic	Hustopece	Hustopece: in declivibus stepposi Pouzdranské kopce ca. 250 -300 m, solo arenacea	250-300	48.941066	16.643232
IB86441	<i>A. exscapus</i>	25.05.1879	Rauscher	Czech Republic	Louny	Kryry	300	50.173778	13.426385
IB86443	<i>A. exscapus</i>	30.04.1925	Boros	Hungary	Budapest	In graminosis siccis vallis Zugliget ad Budapest, 350 m	350	47.51211	18.966316
IB86444	<i>A. exscapus</i>	##.06.1935	Laus	Czech Republic	Pouzdranske	Auspitz: Steppe bei [Pausraus?]	280	48.942612	16.6432
IB86446	<i>A. exscapus</i>	14.05.1932	Kielhauser	Austria	Burgenland	Siegendorfer Puszta	175	47.778063	16.581739
IB86554	<i>A. hellenicus</i>	17.05.1908	Tuntos	Greece	Parnethis	Attica, in regione abiotina nurmes Parnethis	1100	38.16064	23.70633
IB86557	<i>A. transsilvanicus</i>	NA	Barth	Romania	Transylvania	Transylvania, In graminosis prope Egerbegy: 200–250 m (locus classicus)	250	46.071602	24.188922
M-0312145	<i>A. hellenicus</i>	18.06.1981	Erben	Greece	Central Greece	Parnassos, Nordwestseite, alpine Matten, ca. 2000 m	2000	38.54931	22.592294
M-0312146	<i>A. hellenicus</i>	12.05.1895	Heldreich	Greece	Parnethis	in regione abietina m. Parnethis, alt 3500'-4500'	1100	38.159212	23.716988
M-0312147	<i>A. pubiflorus</i>	10.06.1963	Pavlov	Ukraine	Lugansk	prope opp. Starobelsk in steppis, Type	100	49.29729	38.869209
M-0312149	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
M-0312150	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
M-0312151	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
M-0312152	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
M-0312154	<i>A. pubiflorus</i>	25.04.1968	Vitalariu	Moldavia	Vaslui	Moldavia, distr. Vaslui. In pascuis declivi ad sinistram rivi Crasna prope pagum Minjesti. Alt. ca. 120 m	120	46.607131	27.807651
M-0312155	<i>A. pubiflorus</i>	28.05.1968	Vitalariu	Moldavia	Vaslui	Moldavia, distr. Vaslui. In pascuis declivi ad sinistram rivi Crasna prope pagum Minjesti. Alt. ca. 120 m	120	46.607131	27.807651

.....continued on the next page

TABLE 1. (Continued)

Herb_ID	Taxon	Date	Collector	Country	Region	Locality	Elevation m	Latitude	Longitude
M7083	<i>A. transsilvanicus</i>	##.05.1897	Barth	Romania	Transylvania	Transylvania, near Egerbegy (Agârbiciu), 300 m, Locus Classicus	250	46.071602	24.188922
M7085	<i>A. hellenicus</i>	06.06.1860	Leutwein-de Fellenberg	Greece	Parnethis	Attika: auf dem höheren Teil des Parnes im Tannenwald um Hagia triada	1100	38.16064	23.70633
MSB-167823	<i>A. hellenicus</i>	22.06.1981	M. Erben	Greece	Thessalia	Thessalien, Pelion, Lichtungen in Buchenwälder	1500	39.437191	23.0379099

TABLE 2. Comparison of characters of *Astragalus austrobalcanicus* Maylandt & Schöns. *sp. nov.* and closely related and/or morphologically similar *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus*. Metric values correspond to the 10th and 90th percentiles, supplemented by extreme values in parentheses.

Character	<i>A. austrobalcanicus</i>	<i>A. exscapus</i>	<i>A. hellenicus</i>	<i>A. pubiflorus</i>	<i>A. transsilvanicus</i>
Bract length (mm)	(11.5)11.9–15.8(17.5)	(6.9)7.1–10.8(12.9)	(5.4)5.6–7.3(8.7)	(8.3)8.4–9.5(9.6)	(9.8)10.9–15.9(16.9)
Calyx length (mm)	(13.3)16–19.4(20.3)	(11.9)12.5–16.1(16.7)	(11.4)13.4–17.1	13–14.7(15)	(17.2)17.6–19.6(20)
Calyx teeth length (mm)	(6.6)7.3–10.6(11.5)	(5.1)5.9–7.7(9)	(6.1)6.3–8.9(10)	(5.4)5.5–7.4(8.1)	(8.8)8.9–11.2(11.5)
Calyx width (mm)	(4)4.1–5(5.7)	(3.4)3.6–4.8(5.3)	(3.8)4–4.9(5.5)	3.7–4.5(4.9)	(4.2)4.3–5.2
Leaf length (mm)	(219)239–347(379)	(96)136–241(311)	(58)64–136(140)	(75)80–124(131)	(231) 264–322(350)
Leaflet length (mm)	(16.6)17.7–29.2(32)	(9.4)11–16.9(20.9)	(5.7)6.5–12.2(12.8)	(10.8)10.9–13.1(13.2)	(20.1)20.6–26.3(28)
Leaflet width (mm)	(9.4)10.3–15.9(17.8)	(4)4.9–8.3(9)	(4.1)4.7–8.2(9.3)	5–6(6.2)	(7.7)8.5–10.8(12.7)
Leaflet length/width	(1.49)1.55–2.06(2.37)	(1.51)1.67–2.92(3.09)	(1.22)1.33–1.67(1.7)	(2.07)2.09–2.43(2.47)	(1.94)2.15–2.7(2.75)
Leaflet pairs per leaf	(11)12–15(16)	(12)13–15(16)	(7)8–11(12)	9–11(12)	(11)12–15(16)
Pedicel length (mm)	(4.2)4.6–5.9(6.7)	(2.9)3.6–5.9(7.6)	(2.1)2.5–5(6)	(2.4)2.5–5(5.5)	(4)4.7–7.0
Peduncle length (mm)	(10.5)13.2–23.5(37.2)	(6.3)8.9–30.8(44.1)	(3.9)4.2–10.1(13.1)	(4.6)4.9–19	(10.2)13.6–37.2(38.3)
Petiolule lenght (mm)	(0.63)0.67–0.96(1.09)	(0.38)0.51–0.95(1.01)	(0.32)0.36–0.76(0.82)	(0.47)0.51–0.75(0.79)	(0.96)1.28–1.72(1.88)
Standard length (mm)	(25.1)26.5–28.6(30)	(18)20.1–24.7(25.8)	(21.6)22–26.2(28.29)	(20.8)21.6–23.8(23.9)	(25.3)27–29.8(30.9)
Stipule length (mm)	(13.4)15.6–18.9(19.8)	(8.8)12.5–19.1(22.9)	(5.9)6.6–10.4(11.3)	(8.1)9.8–13.9(14)	(13)16–23.7(28.5)
Standard hair number	(42)125–278(316)	0	0–18(38)	(5)10–77(128)	0

For the description of *A. austrobalcanicus*, 21 additional characters were measured from five individuals each from populations 1–3. These are: calyx tube length, fruit beak length, fruit length, fruit width, gynoecium length, keel length, keel blade length, keel blade width, keel claw length, keel claw width, number of flowers per inflorescence, ovary length, petiole length, stamen length, standard width, style length, wing length, wing blade length, wing blade width, wing claw length, wing claw width. Each character value represents the mean of three independent measurements from an individual, wherever possible. Finally, the hair lengths of eight different organs were assessed from the same sample. The organs, where hair length was measured, were bracts, calyces, upper side of leaflets, fruits, petioles, standards, stipules, and wing blades. Each value corresponds to the mean of ten independent measurements. Metric values in Table 2 as well as in the Diagnosis and Description sections correspond to the 10th and 90th percentiles, supplemented by extreme values in parentheses.

Chromosome number estimation

Chromosomes were counted from seeds collected in population 1 and grown in the Botanical Garden of the University of Innsbruck. Root tip meristems were harvested before noon and pretreated with a 0.002 M aqueous solution of 8-hydroxyquinoline for 2 h at room temperature and for 2 h at 4 °C. A freshly prepared mixture of 96% ethanol and

100% glacial acetic acid (3:1) was used for fixation. After 12 h of incubation at room temperature, the samples were stored at -20°C until use. For staining, the fixated meristems were boiled over an open flame in ca. 2–5 ml of 40 % carminic acetic acid for 2–3 mins. Chromosome spreads were prepared by squashing a stained meristem in a drop of 40% carminic acetic acid under the coverslip, and analyzed using an Axio Imager M2 microscope (Carl Zeiss). Images were acquired with a CCD camera and files further processed using AxioVision v. 4.8 (Carl Zeiss).

Results

Astragalus austrobalcanicus is morphologically clearly distinct from closely related, morphologically similar or geographically close *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus* (Table 1, 2). ANOVA analyses followed by Tukey's tests indicated that *A. austrobalcanicus* differed significantly from the other investigated species in most of the characters examined (Fig. 2). The calculated correlation coefficients exceeded 0.85 for character pairs (2)/(3), (2)/(12), (5)/(6) and (6)/(7). Consequently, characters (2) and (6) were excluded from the PCA. As a ratio (15) from characters (6) and (7) was used for the principal component analysis (PCA), character (7) was omitted as well (Table 2). The PCA (first two axes explaining 49.27% and 17.09% of the total variability; Fig. 3) based on 100 individuals and eleven characters, clearly separated all investigated taxa.

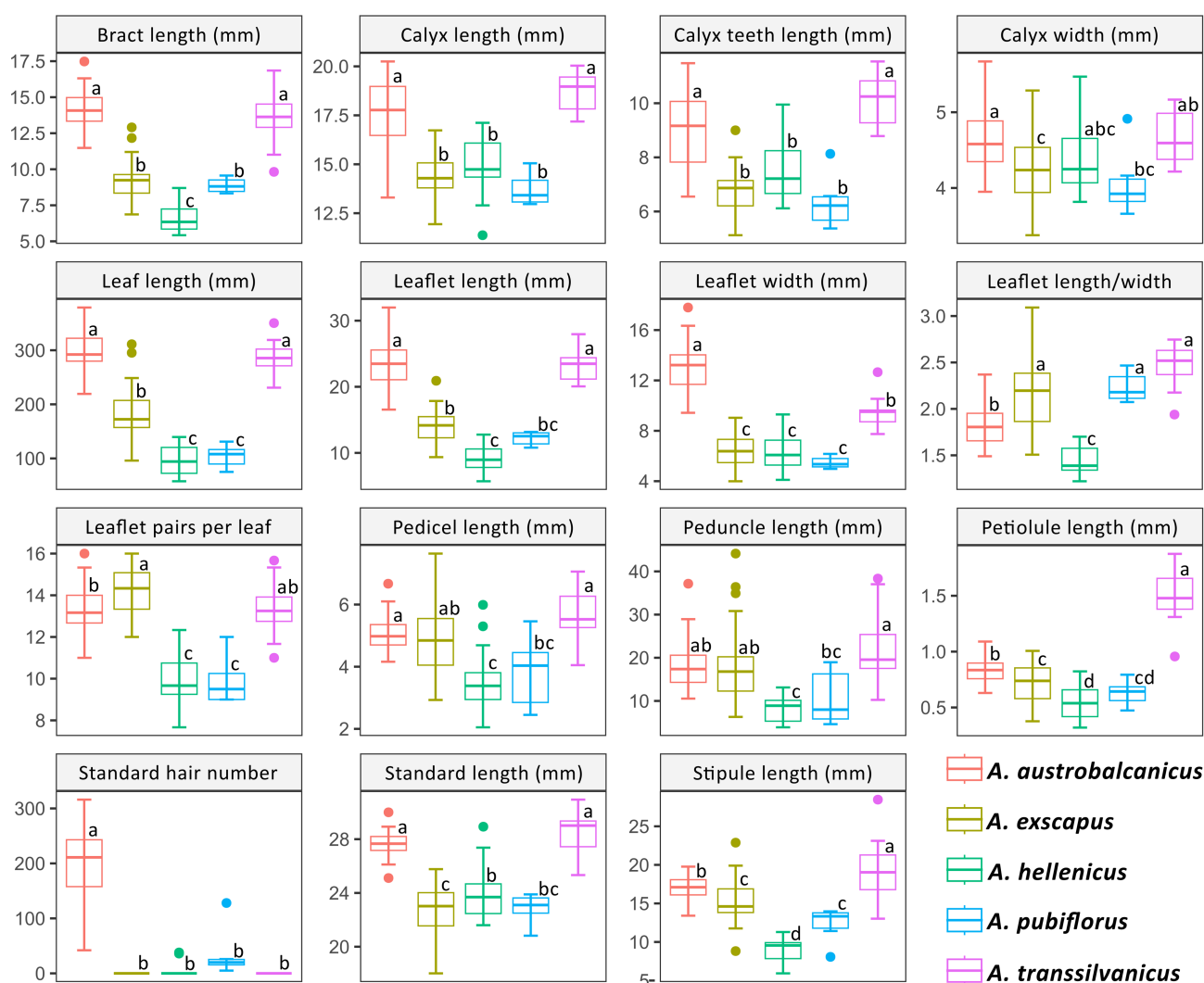


FIGURE 3. Morphometric comparison among *A. austrobalcanicus*, *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus*. Different letters indicate significant differences between respective groupings at $p < 0.001$ based on Tukey's tests.

The chromosome number of *A. austrobalcanicus* is $2n = 16$ (Fig. 4), which corresponds to other species of *A. sect. Caprini* (Podlech, 1988; Martin *et al.*, 2008; Sytin, 2009).

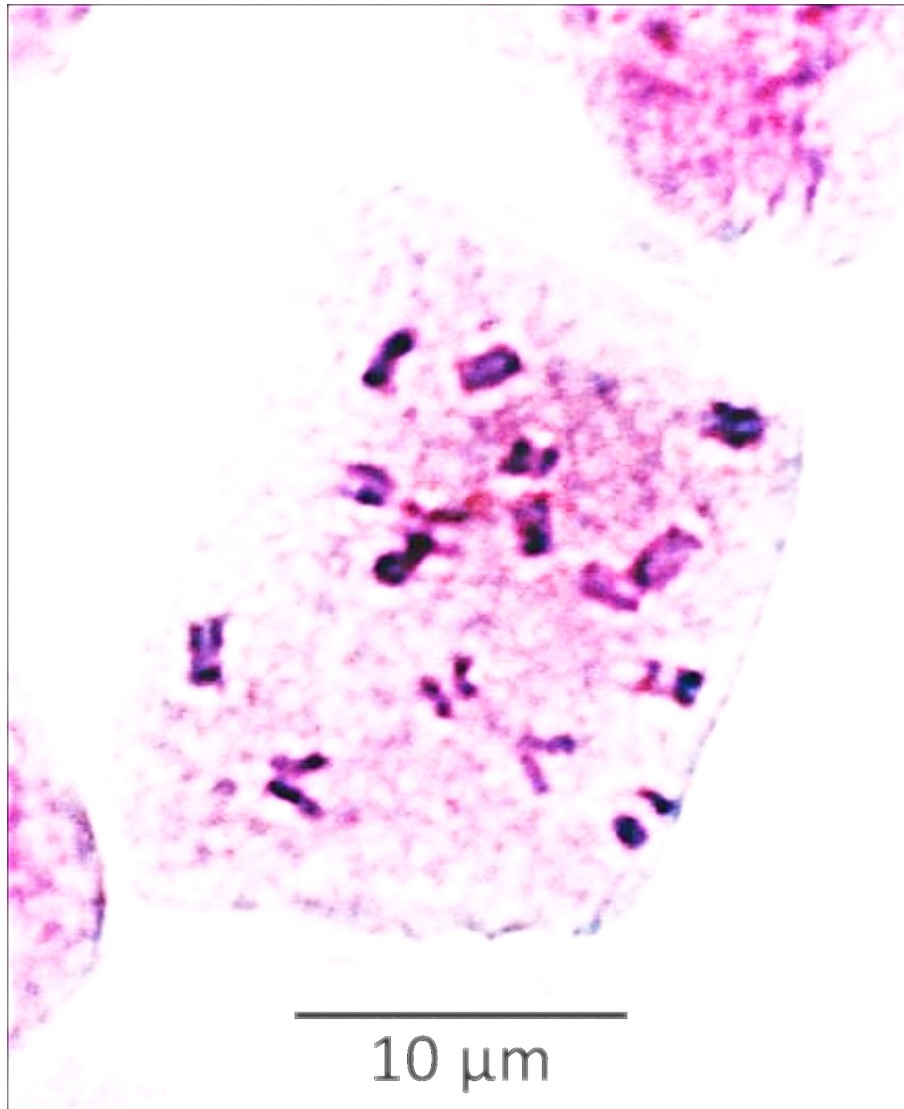


FIGURE 4. Metaphase chromosomes ($2n = 16$) of *Astragalus austrobalcanicus* counted in population 1.

Taxonomy

Astragalus austrobalcanicus Maylandt & Schönschw., *sp. nov.* (Figs. 5–7)

Type:—ALBANIA. Korçë: Ostrovicë mountain range, N 40.579137°, E 20.47462°, mountain steppe, ca. 1500 m a. s. l., 02.06.2024, C. Maylandt & J. Würtl, 114744 (holotype IB!, isotypes W!, M!, and B!) (Fig. 7).

Diagnosis: *Astragalus austrobalcanicus* is closely related to *A. exscapus*, *A. hellenicus*, *A. pubiflorus* and *A. transsilvanicus* (Maylandt *et al.*, 2025). It differs from *A. exscapus* and *A. transsilvanicus* mainly in its hairy petals (except for the keel, which is rarely hairy in *A. austrobalcanicus*). Furthermore, it deviates from *A. exscapus* by a bract length of (11.5)11.9–15.8(17.5) mm (not (6.9)7.1–10.8(12.9) mm), a calyx length of (13.3)16–19.4(20.3) mm (not (11.9)12.5–16.1(16.7) mm), a leaflet length and leaflet width of (16.6)17.7–29.2(32) mm (not (9.4)11–16.9(20.9) mm) and (9.4)10.3–15.9(17.8) mm (not (9.4)10.3–15.9(17.8) mm), respectively, and a standard length of (25.1)26.5–28.6(30) mm (not (18)20.1–24.7(25.8) mm). From *A. transsilvanicus*, which is generally less hairy on all organs (sometimes even glabrous) than *A. austrobalcanicus*, it differs by a leaflet width of (9.4)10.3–15.9(17.8) mm (not (7.7)8.5–10.8(12.7) mm) and a petiole length of (0.63)0.67–0.96(1.09) mm (not (0.96)1.28–1.72(1.88) mm). Further, it differs from *A. hellenicus*, which rarely possesses sparsely hairy petals, mainly by the larger plant size. Consequently, this results in consistently larger organs (Table 2, Fig. 3) in *A. austrobalcanicus*, i. e. a bract length of (11.5)11.9–15.8(17.5) mm (not (5.4)5.6–7.3(8.7) mm), a leaf length of (219)239–347(379) mm (not (58)64–136 (140) mm), (11)12–15(16) leaflet pairs per leaf (not (7)8–11(12)), leaflet length and width of (16.6)17.7–29.2(32.0) mm (not (5.7)6.5–12.2(12.8) mm) and (9.4)10.3–15.9(17.8) mm (not (4.1)4.7–8.2(9.3) mm), respectively, and a stipule length of (13.4)15.6–18.9(19.8) (not (5.9)6.6–10.4(11.3) mm). Finally, *A. austrobalcanicus* differs

from *A. pubiflorus*, which also has hairy petals, by a bract length of (11.5)11.9–15.8(17.5) mm (not (8.3)8.4–9.5(9.6) mm), a calyx teeth length of (6.6)7.3–10.6(11.5) mm (not (5.4)5.5–7.4(8.1) mm), a leaf length of (219)239–347(379) mm (not (75)80–124(131) mm), (11)12–15(16) leaflet pairs per leaf (not 9–11(12)), a leaflet length of (16.6)17.7–29.2 (32.0) mm (not (10.8)10.9–13.1(13.2) mm), a leaflet width of (9.4)10.3–15.9(17.8) mm (not 5–6(6.2) mm), a standard length of (25.1)26.5–28.6(30.0) mm (not (20.8)21.6–23.8(23.9) mm), and a stipule length of (13.4)15.6–18.9(19.8) (not (8.1)9.8–13.9(14) mm). Besides morphological differences, the included taxa in this study are all geographically allopatric (Maylandt *et al.*, 2025). *Astragalus austrobalcanicus* exclusively occurs in a small area in the southern Balkan Peninsula in the Ostrovicë, Gramos and Voio mountain ranges in southern Albania and northwestern Greece.

Description: Herbaceous perennial, acaulescent to very short caulescent, densely covered with simple white hairs (Figs 5–7). Taproot crowned by a pleiokorm with short branches. Leaves imparipinnate, (219)239–347(379) mm long, hairy; petiole (66.7)79.1–110.3(115) mm, like rachis green to straw-colored, hairs (2.0)2.6–3.6(4.0) mm long. Stipules (13.4)15.6–18.9(19.8) mm long, whitish-membranous, partly adnate to petiole, narrowly triangular, hairy at margin, hairs (1.4)1.7–2.4(2.8) mm long. Leaflets in (11)12–15(16) pairs, green, remote, elliptic, (16.6)17.7–29.2(32) × (9.4)10.3–15.9(17.8) mm, (1.49)1.55–2.06(2.37) times longer than wide, rounded and minutely mucronate at the tip, rounded at the base, hairy on both sides, hairs white, (1.5)1.7–2.5(2.8) mm long. Racemes with a short, sparsely haired peduncle (10.5)13.2–23.5(37.2) mm, (3)4–6-flowered. Bracts green to white membranous, (11.5)11.9–15.8(17.5) mm long, linear-triangular, at margins and apex with spreading white (1.7)1.9–3.1(3.4) mm long hairs. Pedicels (4.2)4.6–5.9(6.7) mm, sparsely hairy to glabrous. Calyx (13.3)16.0–19.4(20.3) mm × (4.0)4.1–5.1(5.7) mm, yellowish-green, tubular; tube (4.2)7.5–9.4(11.0) mm long, sparsely hairy; teeth green, linear-subulate, (6.6)7.3–10.6(11.5) mm long, with spreading white hairs, hairs (2.0)2.6–3.3(3.5) mm long. Petals yellow. Standard with green veins on axial surface, (25.1)26.5–28.6(30.0) × (8.7)9.4–10.6(11.0) mm; blade obovate, emarginate, gradually narrowed into a claw. Abaxial surface of standard sparsely to densely hairy (42)125–278(316); hairs occur on the blade and are (0.5)0.6–1.1(1.3) mm long. Wings (22.9)23.7–25.7(27.2) mm long; blade oblong, rounded at apex, (12.4)12.5–14.7(14.9) × 3.4–4.2(4.3) mm, densely to sparsely hairy on the abaxial side, hairs (0.7)0.8–1.3(1.6) mm long; claw (10.3)10.5–12.3(13.1) × 0.6–0.8(0.9) mm (at base); auricle ovate-orbicular. Keel (19.6)19.9–21.9(22.9) mm long; blade oblique-triangular, obtuse, (9.0)9.2–10.4 × (4.1)4.2–4.6(4.8) mm, mostly glabrous, rarely very sparsely hairy on the abaxial side; claw (10.2)10.4–12(12.5) × (0.8)0.9–1.1 mm wide at base; auricle ovate-orbicular. Stamens (16.6)17.2–19.6(19.9) mm long. Pistil (16.7)18.1–20.3(20.5) mm long; ovary (7.2)7.6–9.2(10.2) mm long, ellipsoid, densely hairy, with long hairs (3.1)3.7–5.1(5.7) mm long; style (8.6)10.1–11.5(11.9) mm long, sparsely hairy to glabrous. Legume oblong-cylindrical, (17.3)18.6–21.8(23.4) × (9.0)9.6–10.9(12.5) mm, keeled, with indistinct ventral nerve, widely rounded to flattened, with a rigid, straight to curved beak (5.8)6.2–8.9(9.3) mm long; valves coriaceous, rugulose to rugose, green when unripe to pale brownish-straw colored when ripe, with dense (3.1)3.7–5.1(5.7) mm long spreading white hairs, which later fall off during ripening. Seeds 2.0–4.0 × 2.0–2.7 mm, (pale) brownish with a slight red to violet tone.

Phenology: Flowering from May to June, fruiting from June to July.

Etymology: The epithet “austrobalcanicus” is derived from the species’ restricted distribution in the southern Balkan Peninsula.

Distribution and habitat: *Astragalus austrobalcanicus* is restricted to southeastern Albania (Ostrovicë mountain range) and northwestern Greece (Gramos and Voio mountain ranges). We failed to confirm the occurrence of *A. austrobalcanicus* near Elefthero (Population 4 in Fig. 1) presented in Strid (2024). The species thrives in mountain steppes (Ostrovicë, Gramos) as well as in drought-adapted primary grasslands in naturally open forest vegetation (Voio).

Conservation status: Based on the current knowledge of the species’ distribution, *A. austrobalcanicus* should be classified as vulnerable (VU)—B1a+B2a+D2 based on the IUCN criteria v. 3.1. (IUCN, 2012). The Extent of Occurrence (EOO) is c. 400 km², while the Area of Occupancy (AOO) is 25 km². For the future, a negative impact of land use change such as abandonment of grazing cannot be excluded.

Additional specimens examined: ALBANIA: Distr. Moskopole: W of Korçë, near Gjonbabas towards Ostrovicë, 1330 m, 3.7.1933, Alston & Sandwith 2053 (M!, S, UPS, W); Ostrovicë: über Dorf Marjan, am Janobeg, 8.7.1959, Meyer 3760 (JE); Ostrovicë: zwischen Shtylla und Gjonbabas, 1000–1200 m, 6.7.1959, Meyer 3605 (JE); Quark Korça: Ostrovicë Mts: eastern slopes of Ostrovicë above the village Marjan; 1500 m, 13.07.2018, “alpine” meadow / pasture with *Brachypodium rupestre*, B. Frajman and P. Schönswetter 15127 (IB!).

GREECE: Ep. Konitsis: Nom. Ioanninon, Mt Gramos. Southern side, by forest road c. 4 km WSW of Aetomilitsa, 1500–1600 m, 28.06.2004, Strid & Vassiliades s.n. (M!, LD); Ipiros Ditiki Makedonia, W Makedonia: S ridge of the Mt Voio along the path N of the street Eptachori—Pentalofos, 1474 m, 14.07.2018, open grassland / scrubland in beech forest, flysch, B. Frajman and P. Schönswetter 15135 (IB!).

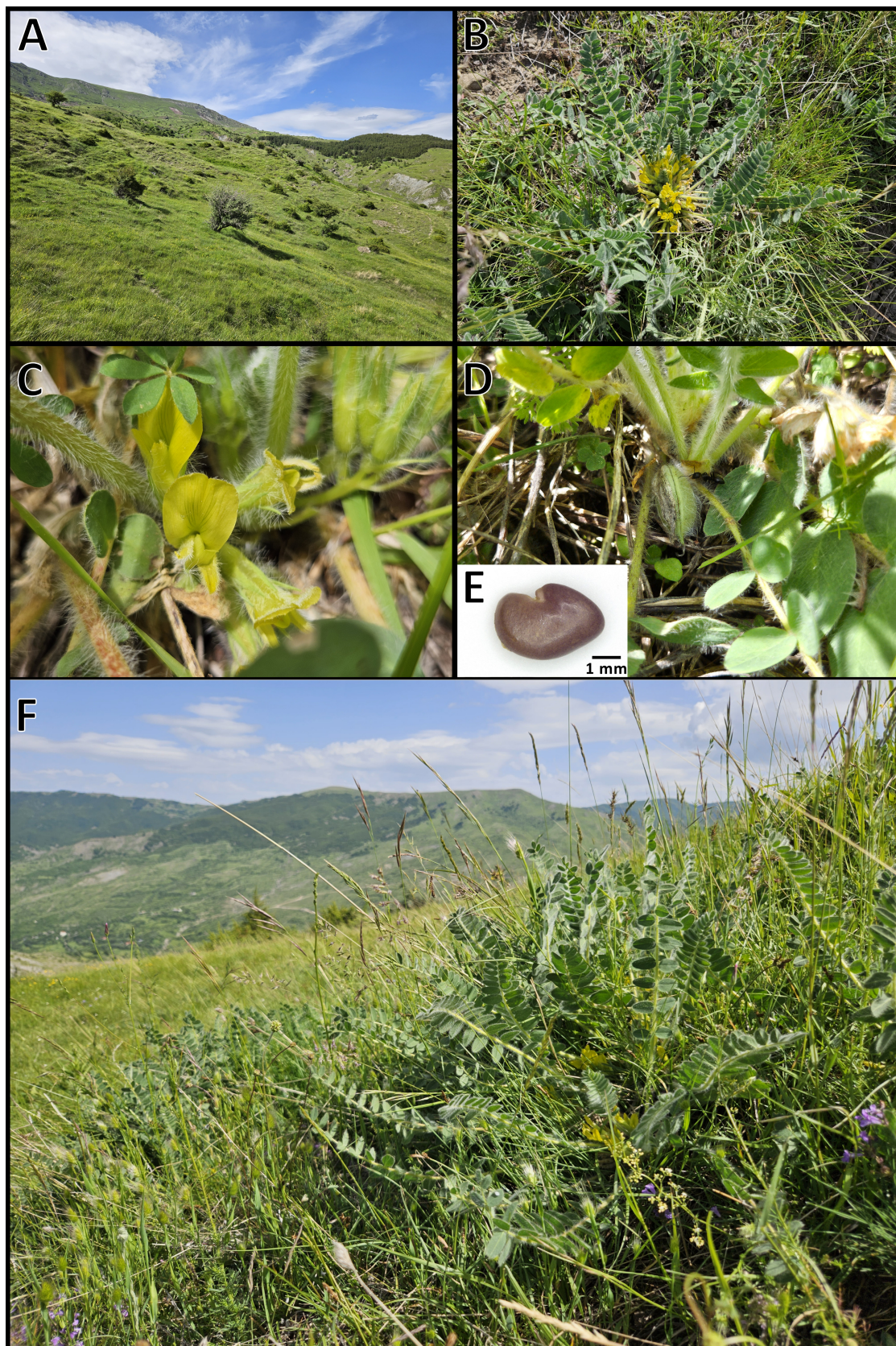


FIGURE 5. *Astragalus austrobalcanicus*. A, habitat; B, flowering individual; C, flowers; D, fruit; E, seed; F, individuals in habitat. Photos taken by Clemens Maylandt on Ostrovicë in May 2024.



FIGURE 6. Iconography of *Astragalus austrobalcanicus* based on a plant growing in the Botanical Garden of Innsbruck from Ostrovicë. Drawing by Elke Huber.



FIGURE 7. Holotype of *Astragalus austrobalcanicus*.

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