

WHAT IS ASTRAGALUS LEUCARGYREUS BORNM. AND WHERE IS ITS SYSTEMATIC POSITION

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Astragalus leucargyreus Bornm. was the first time recollected from the type locality, Hamadan province after the 110 years. Morphological characters, habitat and geographical distribution are presented. Further studies showed that *A. leucargyreus* should be excluded from the sect. *Hymenostegis* Bunge and transferred to the sect. *Adiaspastus* Bunge, then treated as a synonymous with *A. erythrolepis* Boiss.. This study shows that *A. leucargyreus* Bornm. with its morphological feature as a valid species now is transferred from the sect. *Adiaspastus* to its previous the sect. *Hymenostegis* and excluded from synonymous status.

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گونه *Astragalus leucargyreus* Bornm. چیست و موقعیت سیستماتیکی آن چگونه است

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گونه *Astragalus leucargyreus* Bornm. نخستین بار از محل تیپ، استان همدان، پس از گذشت ۱۱۰ سال مجدداً جمع‌آوری شده است. ویژگی‌های مورفولوژیکی، زیستگاه و توزیع جغرافیایی آن ارائه می‌گردد. مطالعات قبلی نشان داد که *A. leucargyreus* باید از بخش *Sect. Hymenostegis* Bunge خارج شود و به بخش *Sect. Adiaspastus* Bunge منتقل گردد، سپس به عنوان مترادف *A. erythrolepis* Boiss. در نظر گرفته شد. این مطالعه نشان داد که *A. leucargyreus* با ویژگی مورفولوژیکی‌اش در حال حاضر به عنوان یک گونه معتبر از بخش *Sect. Adiaspastus* به بخش قبلی خود *Sect. Hymenostegis* منتقل و از حالت مترادف خارج شود.

INTRODUCTION

Astragalus L. (*Fabaceae: Papilionoideae: Astragaleae*), is distributed from E Asia, through Europe to N America. In terms of species number, *Astragalus* may be the largest genus of vascular plants, represented by c. 3000 taxa (Lock & Simpson 1991, Yakovlev et al. 1996). It is also an important component of the Iranian flora, with nearly 850 species (Polhill 1981; Maassoumi 2005). Generally, the genus *Astragalus* is best represented in the steppe areas of high mountains in the Irano-Turanian phytogeographic region of Iran (Chamberlain & Matthews 1970, Podlech 1999).

The sect. *Hymenostegis* Bunge belongs to *Astragalus* subgen. *Astragalus* with basifixed (simple) hairs and a calyx inflated in fruit and unilocular fruits, which remain enclosed by the calyx up to maturity (Podlech 1982). The most conspicuous characters of the section are the \pm large bracts and panduriform standards. Since some species of the closely related and very heterogeneous the sect. *Megalocystis* have similarly \pm large bracts and panduriform standard; there are some difficulties in separating the sections. However, the flowers in the sect. *Megalocystis* are pedicellate contrary to the sect. *Hymenostegis* with sessile flowers. Moreover, most of the species with such a standard in

the former section have black hairs beside the white ones on the calyx, but in the sect. *Hymenostegis* black hairs are always absent (Zarre & Podlech 1996, Podlech & Maassoumi 2001).

Taxonomy of the sect. *Hymenostegis* was the subject of several controversial treatments. The section name was validly published by Bunge (1868, 1869) including originally 23 species and was typified with *A. hymenostegis* Fisch. by Podlech (Podlech, 1990). An inclusive taxonomic revision of the genus was published by Rechinger et al. (1959) with 40 species known at that time [and later for certain areas e.g. the Flora of Turkey (Chamberlain & Matthews 1970), and Flora of Iraq (Townsend 1974)]. The revisions of the genus increased the number of species assigned to this section in Iran (Ghahremaninejad 1992a, 1992b). Later on, Maassoumi (1995) in a local revision for *Astragalus* in Iran increased the number of species to 35 distinct taxa. Contrary to previous studies, a revision provided by Zarre and Podlech (1996) applied a wide species concept in the section and reduced the number of species of this section to 23. Finally, for preparing Flora Iranica treatment (Podlech & Maassoumi 2001) revised the section again with new collections. In this work with describing more new taxa, the number of species increased to about 40 distinct species. Other new species were also described (Podlech 2004, Ghahremaninejad & Podlech 2005, Maassoumi & Maroofi 2006, Maassoumi 2007, Ranjbar 2010, Bagheri et al. 2011). Therefore, with this short historic introduction it seems that with new collections, the number of taxa will be increased and aims to increase the knowledge about patterns of morphological variation in the sect. *Hymenostegis* Bunge in Iran. Based on the recent molecular phylogenetic studies, the section seems to be non-monophyletic and places within a clade including tragacanthic *Astragalus* along with other major groups of spiny *Astragalus* (Kazempour Osaloo et al., 2003, 2005; Kazemi et al., 2009). This placement is in accordance with informal classification presented by Fischer (1853) in some extent.

MATERIAL AND METHODS

During an investigation of the flora of Elwend mountain in Hamadan province, W Iran, one unknown population of *Astragalus* was collected in a slightly disturbed in grassy steppe on mountain slopes (June–July 2010). Collected specimens could not be identified using the keys in Flora Iranica (Podlech & Maassoumi 2001, Zarre et al. 2008). By checking the relevant literature (Boissier 1843, Boissier 1872, Bornmüller

1908, Parsa 1948, Rechinger et al. 1959, Deml 1972, Tietz 1988, Maassoumi 1995, Maassoumi 1998, Zarre & Podlech 1996, Zarre 2000), we came to the conclusion that the specimens are *A. leucargyreus* belonging to the sect. *Hymenostegis*. It was compared to its closest related species e.g. *A. erythrolepis* Boiss. The type specimens of both taxa were examined exactly in the herbaria: B and G-BOIS. Five specimens from the type locality were studied. All materials are deposited in Research Institute of Forests and Rangelands herbarium (TARI).

RESULTS AND DISCUSSION

Evidence for separating the taxa

This study shows that *A. leucargyreus* Bornm. should be excluded as a synonymy of *A. erythrolepis*. Moreover, *A. leucargyreus* Bornm. with its morphological feature should be transferred from the sect. *Adiaspastus* to the sect. *Hymenostegis* Bunge. The evidence is as follows.

1. Literature.

Astragalus erythrolepis Boiss. was originally described from Isfahan by Boissier (1843) as a member of the sect. *Tragacantha*. Boissier (1872) transferred it to the sect. *Acanthophaea*. Parsa (1948) and Rechinger et al. (1959) placed it in the same section. Deml (1972) transferred it to the sect. *Campylanthus*. Tietz (1988) reviewed the sect. *Campylanthus* and kicked it from this section and transferred it to another section (unknown). Based on its initial description and according to Bunge (1868 and 1869), Maassoumi (1995, 1998) transferred it to the sect. *Acidodes*. Finally, Zarre (2000) transferred to the sect. *Adiaspastus* based on non-differentiated standard.

Astragalus leucargyreus Bornm. was originally described from Hamadan by Bornmüller (1908) as a member of the sect. *Hymenostegis*, the same accepted by Parsa (1948). Rechinger et al. (1959). Maassoumi (1995, 1998) and Zarre & Podlech (1996) transferred it to the sect. *Acidodes*. Although Maassoumi (1995) treated *A. leucargyreus* as a different species from *A. erythrolepis*, he did not state the reasons for this treatment. Even in his key, *A. erythrolepis* was not dealt with. The record of *A. leucargyreus* in this work is based on Dini & Bazargan 8677, which belonged to *A. rubrostriatus* of the sect. *Hymenostegis* (see Zarre & Podlech 1996, Zarre 2000). Zarre (2000) and Zarre et al. (2008) transferred it to the sect. *Adiaspastus*, the name *A. leucargyreus* was regarded as a synonymy of *A. leucargyreus* Bornm.

Table 1. Comparison of *Astragalus leucargyreus* with *A. erythrolepis*, *A. pereshkhoranenicus*, *A. uraniolimneus* and *A. woronowii*.

| Characters | <i>A. leucargyreus</i> | <i>A. erythrolepis</i> | <i>A. pereshkhoranenicus</i> | <i>A. uraniolimneus</i> | <i>A. woronowii</i> |
|------------|---|---|--------------------------------------|-----------------------------------|-----------------------------------|
| Leaflet | obtuse at the tip, appressed-lanate hairy | obtuse at the tip, appressed-lanate hairy | acute at the tip, subappressed hairy | acute at the tip, appressed hairy | acute at the tip, appressed hairy |
| Bracts | papery, 6-7 mm long | papery, 6-8 mm long | membranaceous, 9-15 mm long | membranaceous, 8-12 mm long | membranaceous, 7 mm long |
| Calyx | 8-12 mm long | 8-12 mm long | 15-20 mm long | 12-16 mm long | 12-15 mm long |
| Peduncle | 2-2.5 cm long | absent | 1.5-7 cm long | 2-5 cm long | 2-5 cm long |

2. Morphology.

Astragalus erythrolepis is a very rare and interesting species only known from the type material, which seems in some respects, such as the relatively long hairs on the calyx and wide bracts, is similar to the species of the sect. *Hymenostegis*. In fact, Bornmüller (1908), when described *A. leucargyreus* treated it as a member of this section. However, most species of this homogeneous section have a standard distinctly differentiated into claw and limb contrary to typical species of the sect. *Adiaspastus* with a standard not differentiated into claw and limb (e.g. *A. woronowii*) (see also Zarre & Podlech 1996, Zarre 2000). Another feature that connecting *A. erythrolepis* and *A. leucargyreus* to the sect. *Hymenostegis* is the type of inflorescence, which is non-glomerate and consists of c. 10 flowers with a relatively well-developed peduncle. In revising the herbarium materials in G-BOIS (Aucher-Eloy 1274), the type material of *A. erythrolepis* is a mature plant and therefore the ovary is fully developed and standard is fully elongated. The size of the inflorescence and its peduncle can be determined, the peduncle is absent or is not more than 0.5 cm long (in *A. kohrudicus* Bunge of this section the peduncle is 0.5-1.5 cm long). The type material of *A. leucargyreus* which is a young plant, the peduncle is up to 2.5 cm long. Moreover, the number of paraclades on each shoot is not more than two on the both type materials, which is again not characteristic for the sect. *Adiaspastus*. Zarre (2000) treated *A. erythrolepis* as a member of the sect. *Adiaspastus* (that is more or less similar to *A. leiophyllus*), because of possessing black hairs on the calyx and more than three paraclades on the flowering shoots, which form a subglomerate inflorescence. In addition, the shape of stipules in both species is reminding *A. iodotropis*, which also has black hairs on the calyx.

Appressed-lanate leaflets are the most conspicuous character of the species. *A. erythrolepis* and *A. leucargyreus* having no close relative in the sect. *Adiaspastus*.

Here, these species are clearly transferred from the sect. *Adiaspastus* to the sect. *Hymenostegis*.

Studies on new material of *A. leucargyreus*, from the type locality (Strauss 6.1902), confirms its placement in the sect. *Hymenostegis* because of the

long and terminal peduncle and relatively inflated calyx, the characters remove it from the sect. *Adiaspastus*.

A. leucargyreus is morphologically similar to *A. pereshkhoranenicus* Boiss. and *A. uraniolimneus* Boiss. from the border region of Azerbaijan province and *A. woronowii* Bornm. from Transcaucasica; but important differences are as follows, in *A. leucargyreus* leaflets are obtuse at the tip and minutely mucronulate, both surfaces are always densely appressed-lanate, bracts are papery and 6-7 mm long, calyx is 8-12 mm long (Table 1).

3. Ecology

A. leucargyreus grows on Elwend mountain in Hamadan province (W Iran) where one small and homogenous population consisting of no more than 30 plants was observed, sparsely scattered in a grassy steppe on mountain slopes with aren soil, on steep alpine taluses, 3200-3300 m altitude, flowering June-July, and has not been seen elsewhere. It seems that the distribution of *A. erythrolepis* is not wide enough to reach to the Hamadan province. This species has not been collected after the type collection from 169 years ago. Also it has not been observed among the specimens from the type locality in Isfahan and Bakhtiari provinces. However, it seems that the two species should be distinct taxa.

It is necessary to mention that except some species with wide distribution pattern (e.g. *A. hirticalyx* Bunge, *A. kapherrianus* Fisch., etc.), the majority of the species are narrow endemics and localized to the small areas (e.g. *A. altiusculus* Maassoumi & Ghahremani, *A. bradosticus* Maassoumi & Podlech, etc.). Since ecological niche in many species is small, it is hard to accept that the distribution of *A. erythrolepis* extends from Isfahan area to Hamadan province.

Distribution of *A. leucargyreus* is ecologically similar to *A. woronowii*, *A. pereshkhoranenicus*, *A. uraniolimneus*, and *A. erythrolepis* and as these species are localized to high altitudes in small areas, therefore, *A. leucargyreus* and *A. erythrolepis* may occur in different areas.

4. Prediction

It is true that the type locality of *A. erythrolepis* [Persia, Ispaha (Aucher-Eloy 1274)] is not very clear and on the other hand, since it has not been recollected after the



Fig. 1. *Astragalus leucargyres* (Type specimens from Berlin Herbarium).

type collection, we prefer not to regard it as a synonym of a distinct species. But, rather to put it in exploration programs.

Treatment

In this investigation, we regard *A. leucargyres* as a distinct species from *A. erythrolepis* and both from the

sect. *Hymenostegis*. We, also present an epitypus for the former species, as the type material is poor and not informative.

Astragalus leucargyres Bornm., Mitth. Thür Bot. Vereins, ser. 2, 23: 13. 1908.

Typus: Persia occidentalis (Media), in regione alpina montis Elwend, ditionis Hamadan, 6.1902, Leg.: Th. Strauss. (B). -Fig. 1.

Epitypus: W Iran. Hamadan province: Tuyserkan, Artyman village, Serkan district, Elwend mountain, Shah-neshin peak, 34°36'46"N, 48°31'49"E, alt. 3200-3300 m, 4.VI.2010 to 17.V.2010, M. M. Dehshiri & H. Mostafavi 95790 (TARI). -Figs. 2-3.

Cushion-forming plant up to 10 cm tall and 30 cm in diameter, woody at the base, rigid. Stipules hyaline, glabrous but ciliate on the margin. Leaflets 6-7 pairs, folded or flattened, densely covered with subappressed to spreading grayish to silvery hairs. Racemes pedunculate, composed of 7-12 flowers, globose; peduncle 2-2.5 cm long, covered with long spreading hairs. Bracts papery, remotely ciliate on the margin, persistent, yellowish at the base, rarely purplish toward the tip, ovate, c. 6-7 mm long. Calyx tubular, shortly inflated, with 5 purple veins, not rupturing until fruiting time, yellowish, purple towards the teeth, densely covered with long hairs up to 2.5 mm long. Petals dark purple. Standard 20-22 mm long, the limb oblong-elliptic to narrowly obovate, not differentiated into claw and limb.

Astragalus erythrolepis Boiss., *Diagn. Pl. Or. Nov.* ser. 1, 2: 65. 1843.

Typus: Persia ad Ispahan, Aucher-Eloy 1274 (G-BOIS). -Fig. 4

Cushion-forming plant up to 17 cm tall, woody at the base, rigid. Stipules thinly membranous, hyaline, sparsely pilose, later becoming glabrescent, mostly ciliate on the margin. Leaflets 6-8 pairs, folded or flattened, densely covered with subappressed to spreading grayish to silvery hairs. Racemes epedunculate, not glomerate, composed of 5-7 flowers, globose; peduncle absent. Bracts papery, yellowish at the base, purplish toward the tip, c. 6-8 mm long. Calyx tubular, shortly inflated, not rupturing until fruiting time, yellowish, purple towards the teeth, densely to sparsely lanate. Petals pink to red, with 13-17 parallel thin nerves. Standard 20-22 mm long, the limb oblong-elliptic, not differentiated into claw and limb.

Specimens examined. Persia, Ispahan, Aucher-Eloy 1274 (G-BOIS).

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Fig. 2. Habit and flowering habitat of *Astragalus leucargyreus*.

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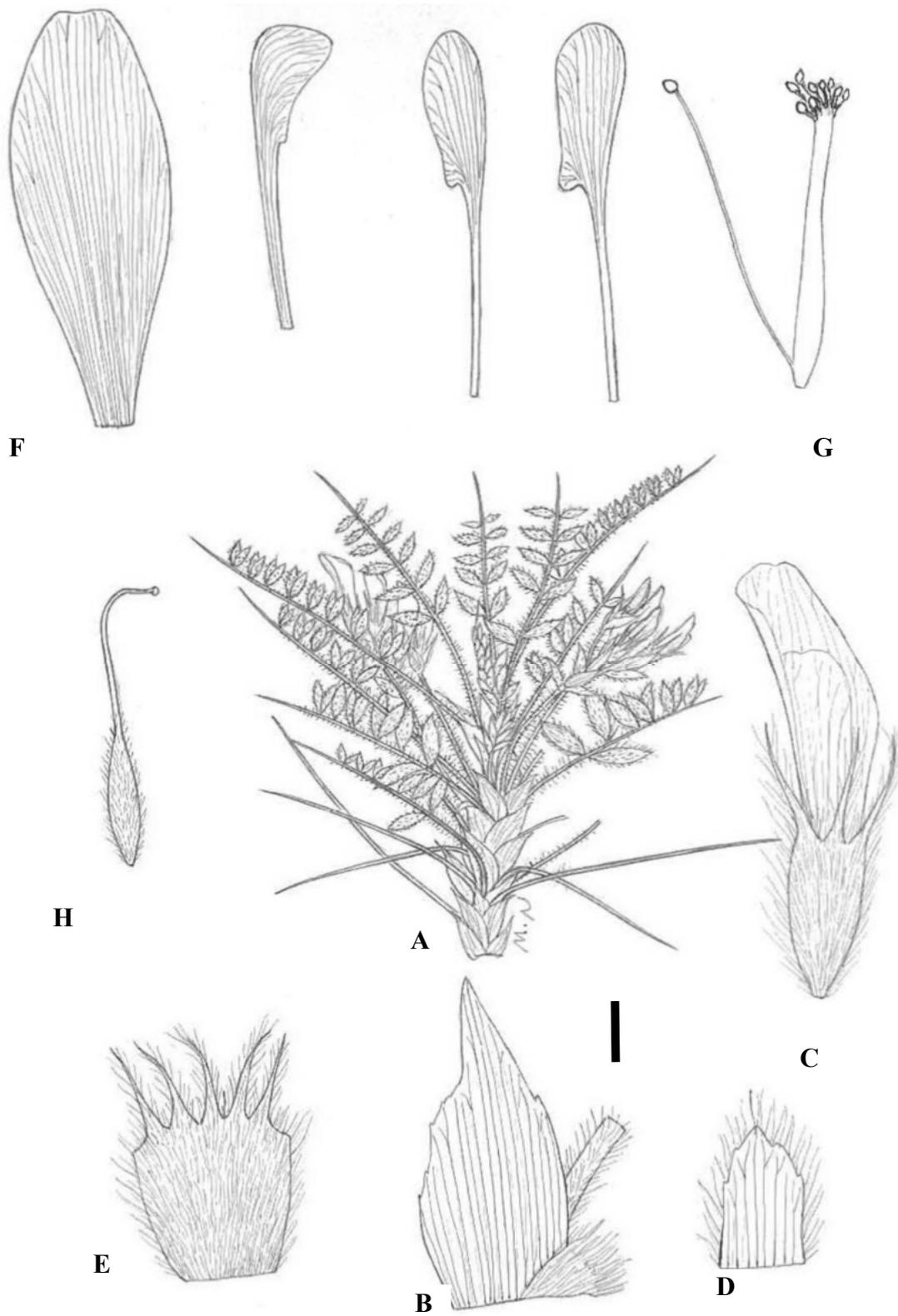


Fig. 3. *Astragalus leucargyreus* (from the epitype). A: Habit. B: Stipule. C: Flower. D: Bract. E: Calyx. F: Corolla parts (from the left, standard, keel and wings). G: Stamens. H: Pistil. Scale bar: A: 1 cm, B-H: 0.25 cm.



Fig. 4. *Astragalus erythrolepis* (type specimen from G-BOIS Herbarium).

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