Oxytropis iridum (Leguminosae), a new species from SE Tibet (Xizang, China), including phytogeographical notes

Authors: Dickoré, Wolf Bernhard, and Kriechbaum, Monika

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WOLF BERNHARD DICKORÉ & MONIKA KRIECHBAUM

Oxytropis iridum (Leguminosae), a new species from SE Tibet (Xizang, China), including phytogeographical notes

Abstract

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Oxytropis iridum is described as a species new to science from the Inner E Himalaya of the Xizang Autonomous Region. The new species is well defined by its morphological traits, geographical distribution and habitat preferences and belongs to the largest and probably most controversial, typical subgenus of *Oxytropis.* It is apparently most closely related to the circumarctic *O. deflexa* (Tibet, N Asia, W North America) and to the W Himalayan endemic *O. mollis*.

Key words: *Fabaceae, Oxytropis deflexa, Oxytropis mollis,* taxonomy, phytogeography, Himalaya

Introduction

In the course of a joint Sino-German expedition in 1994, the first author repeatedly came across a rather conspicuous species of *Oxytropis* DC. *(Leguminosae-Papilionoideae / Fabaceae)* in the Upper Kuru Chu Valley (S Tibet/E Himalaya), about 10-50 km north of the border with Bhutan. It was not possible to identify the species and subsequent research in the herbaria B, BM, E, GOET, K, KUN, RAW, SZU, W, WHB, WU and Z (abbreviations following Holmgren & Holmgren 1998-) brought about just two additional specimens of apparently the same taxon from S Tibet at BM identified as *O. mollis* Benth. Furthermore, a record and figure in Flora Xizangica (Li 1985) under *O. mollis* from Lhunze, S Tibet, clearly refers to the same new species, which seems to have also passed for *O. mollis* in a recent monograph of Chinese *Oxytropis* (Zhu & Ohashi 2000). However, except for a similar leaf outline, the new species substantially differs from the W Himalayan *O. mollis,* but is also similar to *O. deflexa* (Pallas) DC. The latter species is widely distributed through Asia and W North America and also occurs, in a scattered and disjunctive manner, around the Tibetan Plateau.

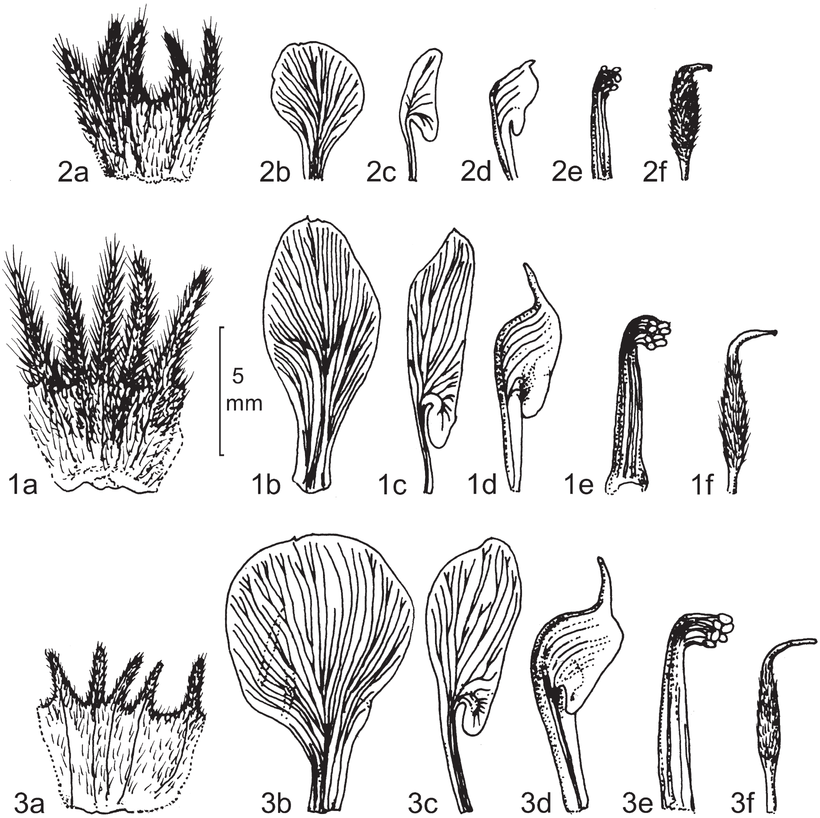

Fig. 1. Flower analyses of 1: *Oxytropis iridum (B. Dickoré 9435);* 2: *O. deflexa* (China, Qinghai, *Miehe 9314/11a*, herb. Miehe); 3: *O. mollis* (India, Himachal Pradesh, Lahul, *M. Kriechbaum 613,* WHB). – a = calyx, b = vexillum, c = wing, d = keel, e = stamen tube (free stamen omitted), f = gynoeceum.

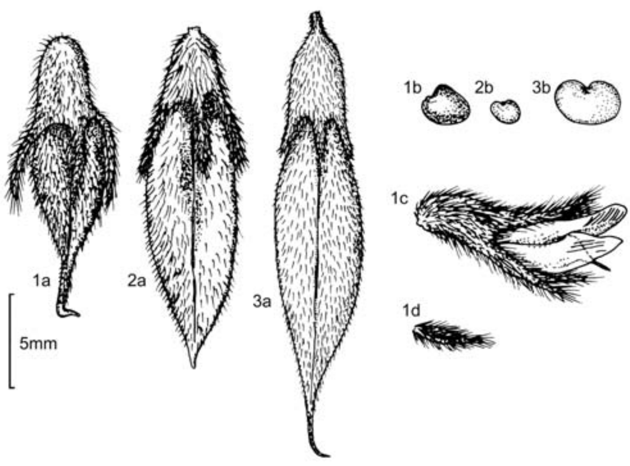

Fig. 2. Fruit and flower of 1: *Oxytropis iridium (B. Dickoré 9451);* 2: *O. deflexa (Miehe 9314/11a,* herb. Miehe); 3: *O. mollis* (Pakistan, Northern Areas, Astor, *A. Millinger 3197*, SZU). – a = fruit, abaxial view, b = seed, c = flower, lateral view, d = bract.

Oxytropis iridum Dickoré & M. Kriechb., **sp. nov.**
Holotype: China, Xizang, S Tibet, Tibetan Himalaya N of Bhutan, 5 km W of Lhozak, 28°22'N 90°45'E, 4020 m, mont. dwarf-scrub, dry slopes, siliceous schist, 17.7.1994, *B. Dickoré 9435* (B; isotype: PE).

Differt ab *Oxytropide deflexa* radice crassiore caudiceque lignoso; caule plusminusve producto, scapo folia basalia manifeste prominente; inflorescentia multiflora post florescentiam valde elongata, cylindrica, 5-8 cm longa; floribus valde majoribus, carinis longiore mucronatis; leguminibus abrupte stylosis, hexaspermis; seminibus majoribus. Differt ab *Oxytropide molli* indumento subpatente et pilibus longioribus; dentibus calicis longioribus tubo aequantibus; vexillo oblanceolato; leguminibus et seminibus minoribus.

Herb with a stout taproot to > 15 cm long (possibly to several metres), 0.5-1 cm in diameter at top, forming at surface level a caudex, either being conspicuous, compact and to 3 cm in diameter, or having up to 5-10 short branches to 1 cm in diameter, densely covered with somewhat indurated rachis and stipular remains. *Plant* with a basal leaf rosette, acaulescent or with a leafy stem up to 10 cm, scapes or stems 7-25 cm long, erect or ascending, solitary or up to ten, usually exceeding the length of the rosette leaves by approximately one third or more. *Indumentum* of stem, scape, stipules, rachis, leaf blade, bracts, calyx and fruit moderately to densely villous, composed of predominantly white, long, subpatent hairs, and with fewer, short, appressed brown or blackish hairs. *Stipules* free (connate in lower $^1/_6$), triangular-lanceolate, acuminate, 5-10 × 1-3 mm. *Leaves* 4-12 cm long, 1-5 cm petiolate, imparipinnately compound with c. 15-30 distantly to closely set (± touching) leaflets; *leaflets* involute to plane, alternate to subopposite, slightly asymmetric, variable in form and size, lanceolate to ovate, 3-15 × 1-9 mm. *Inflorescence* terminal with c. 8-30 flowers, globose during flowering, 1-2 cm in diameter, distinctly elongating after flowering and becoming cylindric and 5-8 cm long in fruit. *Bracts* linear to narrowly lanceolate, 5-7 × 0.3 mm, pilose with long, patent, white hairs and with short brown hairs. *Flowers* subsessile, pedicellate to 1 mm in fruit; flower buds erecto-patent, becoming markedly reflexed on opening. *Calyx* tubular-campanulate, 8-10 mm long, with subulate teeth approximately equal to or slightly longer than the 4.5-5.5 mm long cup. *Corolla* red-lilac (yellowish white with purple streaks in bud, bluish violet at end of flowering), standard adaxially with a large white blotch, wings and keel darker red-lilac; *standard* oblanceolate, 11 × 4.5 mm, narrowed at base, minutely apiculate at tip; *wings* lanceolate, 10 × 5 mm, slightly shorter than standard, distinctly auriculate, clawed 3.5 mm; *keel* 9 mm long, with a mucro 1.7 mm long; *stamen tube* 6.7 mm long; *anthers* ovate, 0.5 mm long; *gynoeceum* c. 5.8 mm long, densely appressed white-hairy except stipe and style, stipitate 0.7 mm, style bent upwards at a right angle, 1.5 mm long. *Fruit* reflexed, with persisting calyx, compressed-ovoid, 13-16 mm long, stipitate c. 2.5 mm, with curved or hooked style 3-5 mm long, opening along the adaxial suture, eseptate. *Seeds* c. 6 (3 on each side of the suture), triangular-reniform, flattened, yellowish brown, 2-2.5 mm in diameter but often smaller and then probably abortive.

Ic. – Fig. 1.1, 2.1; Plate 1, see electronic supplement at http://www.bgbm.org/willdenowia/willd36/dickore+kriechbaum.htm. – Li 1985: fig. 286 (1-7, as *Oxytropis mollis*).

Etymology. – The word iris (genitive plural: iridum) is the latinized form of the Greek word for “rainbow” (cf. Sinus Iridum, the “bay of rainbows”, on the moon). During the summer monsoon, we experienced the area of the type locality as the “land of a permanent rainbow”. All known localities of the new species align to a narrow zone of transition between humid and arid climates on the border between the Inner E Himalaya and SE Tibet, which are likely to display similar climatic features. The epithet shall also allude to the somewhat multicoloured flowers of the new species.

Delimitation. – The new species is similar to *Oxytropis deflexa* and, in particular, to *O. mollis,* but is very clearly separated from both species as is summarized by Fig. 1-2 and Table 1.

Table 1. Differential characters of *Oxytropis iridum, O. mollis* and *O. deflexa*. – Data of *O. deflexa* are only from Central Asiatic specimens, while the range of morphological variation known in this species is definitely higher in North American material.

	O. iridum	***O. mollis***	***O. deflexa***
Root, caudex	taproot thick, caudex woody, 0.5-1 cm in diam.	pleiocorm extensively branching, caudex herbaceous	taproot slender, caudex herbaceous, to 0.5 cm in diam.
Stem, leaves	stem absent or present, to 10 cm, leafy; scapes or stems usually surpassing rosette leaves by c. 1/3	stem absent, scapes ± as long as rosette leaves	stem absent, scapes ± as long as rosette leaves
Indumentum (of axes and leaflets)	subpatent long hairs	appressed short hairs	subpatent long hairs
Inflorescence	(5-)7-25(-40)-flowered, axis postflorally strongly elongating to 5-8 cm	5-10-flowered, globose to postflorally slightly elongating to 3 cm	3-10(-15)-flowered, globose, postflorally slightly elongating to 4 cm
Indumentum of calyx	subpatent long white hairs and appressed short brown-black hairs on cup and teeth	appressed long white hairs on cup, subpatent short brown hairs on teeth	appressed to subpatent short and long brown-black hairs and white hairs on teeth and cup
Flowers	10-12 mm	11-14 mm	4-6 mm
Calyx	calyx teeth ± as long as to slightly longer than cup	calyx teeth shorter than cup	calyx teeth ± as long as cup
Standard	oblanceolate c. 11 × 4.5 mm	obovate to suborbicular, c.11 × 7 mm	obovate c. 5 × 3.5 mm
Mucro of keel	c. 1.7 mm	c. 2.1 mm	c. 0.3 mm
Legume	13-16 mm, stipitate c. 2.5 mm, abruptly contracted into a hooked style of 3-5 mm	20-25 mm, stipitate c. 4 mm, contracted into a hooked style of 5-6 mm	18-21 mm, stipitate c. 1.5 mm, gradually narrowed into a short, straight style of c. 1.5 mm
Seeds	c. 6, triangular-reniform, 2.5 mm in diam.	c. 6, oblong-reniform, 3.5 × 2.5 mm	c. 12, rounded reniform, 1.5 mm in diam.

Distribution

Oxytropis iridum is presently known from three occurrences in SE Tibet/Xizang, which align to the crest line of the E Himalaya close to the northern boundaries of Bhutan and India (Fig. 3). The new species has repeatedly been found in the Upper Kuru Chu, north of the massif of Mt Kula Kangri (7554 m), while single herbarium specimens were located from the upper Subansiri Valley north of Mt Kangto (7089 m) and from a smaller tributary (Tamnyen Chu) of the Tsangpo River, about 50 km SW of Mt Namchabarwa (7756 m). The west-east extension of the known distribution is about 450 km. Since the species was found only 5-10 km from the respective borders, it may also turn up in adjacent N Bhutan or Arunachal Pradesh (Assam), India. The occurrences of *O. iridum* evidently concentrate in the shelter of the E Himalayan high massifs or in the gorge or headwater sections of the rivers that cut into or through the Himalayan main range, where this is generally lower and more dissected as compared to the Central Himalayas.

Zhu & Ohashi (2000) cite two specimens under *"Oxytropis mollis"* for Xizang (Tibet). The first specimen "on riverland and near field, near Jiayu, Lhunze Xian, 3000 m, 1.7.1975, *Qingzangbudian 750425*" (PE, not seen), is very likely also referable to *O. iridum*. The other specimen "Tibet [Occ.], 12000ft, 1852, *T. Thomson*" (K) should refer to *O. mollis* sensu lato, possibly being type material of *O. thomsonii* Bunge. However, this was almost certainly collected in NW India;

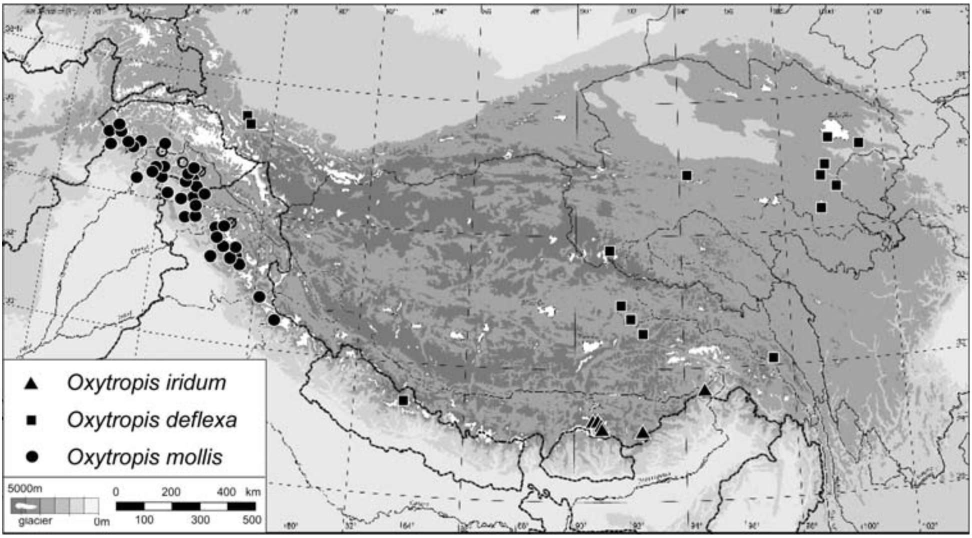

Fig. 3. Distribution of *Oxytropis iridum, O. deflexa* and *O. mollis* on the Tibetan Plateau. – Solid symbols represent specimens seen, empty circles (in *O. mollis*) denote doubtful and geographically unsharp records. – Basemap by C. Enderle & G. Miehe (Miehe & al. 2001), modified; specimens seen of *O. deflexa* and *O. mollis,* according to B. Dickoré, Flora Tibetica Database, are listed in the electronic supplement to this paper.

from the collecting year most probably in or around the Kashmir Basin. Thomson's specimens are, unfortunately, often collectively labelled and mounted. Their exact provenance can often be reconstructed from small date labels of the Kew set together with Thomson's report (Thomson 1852). However, although Thomson got in several instances very close to the Tibetan border and eventually even crossed a short distance into Tibetan territory, we do not know of a single example, of an unequivocal record for Tibet proper. Accordingly, *O. mollis* seems to be unknown from China. However, this W Himalayan species is still very likely to turn up in the upper Sutlej Valley, on the southwest border of Tibet, and thus also close to Thomson's route. Specimens seen of *O. mollis* and *O. deflexa* are listed in the electronic supplement of this paper (see above, under Ic.).

Specimens seen. – China, Xizang, Tibetan Himalaya: Upper Kuru Chu: Gorge 10 km W of Lhozak, 28°22'N 90°40'E, 4150 m, 17.7.1994, *B. Dickoré 9460* (K, W); W of Lhozak, 28°22'N, 90°45'E, 4080 m, 17.9.1998, *G. & S. Miehe 98-13405* (herb. Miehe); E of Lhozak, 28°22'N, 90°51'E, 3860 m, 17.7.1994, *B. Dickoré 9451* (B); Lhozak Vy., hill E of junction, 28°21'N, 90°54'E, 4660 m, 20.7.1994, fl. violet-white, *G. Miehe & U. Wündisch 94-78-16* (herb. Miehe); Lhozak to Lakhang Dzong, 15 km N of Lakhang, 28°9'N, 90°57'E, 3550 m, 21.7.1994, *B. Dickoré 9601* (GOET). – Upper Subansiri: Karta, [28°4'N 92°27'E], 13000ft, 16.6.1935, *F. Kingdon Ward 11726* (BM). – Lower Tsangpo: Tamnyen Chu, 11500 ft, 29°20'N, 94°43'E, *Ludlow, Sherriff & Taylor 4962* (BM).

Habitat

Oxytropis iridum was found at altitudes of 3500-4150 m (once at 4660 m). These elevations can roughly be referred to a semiarid, montane/subalpine belt of vegetation, which corresponds in S Tibet to a rather complex thermo-hygric treeline situation, and to a narrow zone of transition between the warm, summer-humid climate of the Himalayan south slopes and cold-arid conditions on the Tibetan Plateau. The climate station of Lhunze, 3860 m (Miehe & al. 2001), may give an estimate for the general area, i.e. mean annual temperature 5.2 °C, mean minimum of the coldest month -13.5 °C, mean maximum of the warmest month 20.7 °C, total annual precipitation

258 mm, while June to September are relatively humid. Due to an apparently very exposed situation at Lhunze town, both temperature and precipitation values may be higher where the new species actually occurs.

Habitat preferences of *Oxytropis iridium* can be circumscribed for the upper Kuru Chu, where the species has repeatedly been collected. The steep rock and scree slopes at the respective altitudes have a steppe and scrub vegetation with total plant cover usually not exceeding c. 50 % of the surface, often less. The generally barren and arid-looking aspect is, however, much varied with exposure and altitude and torrential rains during monsoon seem to occur regularly, also at the relatively lower altitudes. Dense shrub and pockets of closed forests are regular features at the higher altitudes in this general area. Habitats of *O. iridum* are grassy ledges on steep rock face, dwarf-scrub, dry slopes, siliceous schist, dry overgrazed dwarf scrub, grazed scrub on mudflow accumulation fans, *Juniperus* dwarf-scrub patches on open limestone debris on upper wind-blown south facing slope, along irrigation channels, ruderal by water courses, and roadsides. Somewhat sheltered and shady, grassy ledges on steep rock faces and relatively stable scree slopes seem to represent typical habitats. Since almost every suitable strip of land along the river bottoms, as well as of the high mountain shoulders is under cultivation, it seems not surprising that *O. iridum* occupies also secondary habitats such as roadsides and irrigation ditches among cultivated fields and alluvial scrub. Relatively intense grazing of domestic stock seems also tolerable to the new species. Preferences as to soil and geology are apparently rather unspecific, though possibly obscured by the huge relief and geological diversity of the area. The species was observed on various raw soils, among rocks and scree composed of siliceous schist, granite and also limestone.

Companion species of *Oxytropis iridum* in the Upper Kuru Chu were various shrubs and dwarf shrubs such as *Berberis* cf. *umbellata* Don, *Berchemia edgeworthii* Lawson, *Caragana jubata* (Pall.) Poir., *Ceratostigma minus* Prain, *Clematis tibetana* Kuntze, *Cotoneaster obovatus* Dunn, *Rosa sericea* Lindl., *Ephedra intermedia* C. A. Mey., subshrubs and herbs such as *Anisodus luridus* (Dun) Link & Otto, *Dracocephalum tanguticum* Maxim., *Euphorbia wallichii* Hook. f., *Leontopodium stracheyi* Hemsley, *Oxytropis microphylla* (Pall.) DC., *Silene waltonii* F. N. Williams, *Artemisia waltonii* Pamp., *A. xigazeensis* Ling & R. Ling, *A. younghusbandii* Pamp., bunch grasses and sedges such as *Festuca nepalica* Alexeev, *Stipa breviflora* Griseb., *S.* cf. *roborowskyi* Roshev., *Carex pachyrrhiza* Franch., and xerophytic ferns such as *Mildella straminea* (Ching) C. C. Hall & Lellinger, *Platygyria waltonii* (Ching) Ching & S. K. Wu, *Drynaria mollis* Bedd.

At relatively higher altitudinal levels, approximately between 4400-4600 m and usually above the altitudinal belt where *Oxytropis iridum* occurs, pockets of forest or dense subalpine scrub (*Betula utilis* D. Don, *Juniperus tibetica* Kom., *Rhododendron wallichii* Hook. f.) were seen, occasionally with solitary trees of *Picea spinulosa* (Griff.) A. Henry, well guarded among almost impenetrable *Rhododendron* krummholz. The alpine flora is rich in species and of a typical humid E Himalayan character (*Kobresia* spp., *Pedicularis* spp., *Saussurea* spp., *Leontopodium jacotianum* Beauv., *Diapensia purpurea* Diels, *Lycopodium veitchii* H. Christ, *Picrorhiza scrophulariaefolia* Pennell), but also with other geographical elements such as *Pinguicula alpina* L. (Eurasiatic) and *Oxytropis pusilla* Bunge, which seems to represent the easternmost known station of this SW Tibetan species.

Relationship and phytogeography

Species delimitation in *Oxytropis,* with about 1000 published epithets, is notoriously difficult and taxonomic treatments (Li 1985, Grubov 1998, 2003, Zhu & Ohashi 2000, Zhu & al. 2002) are to a considerable extent controversial. Inflation and possibly widely diverging use of species names further obscure the picture. Moreover, the infrageneric classification of *Oxytropis* seems not to have substantially improved since the comprehensive treatment of Bunge (1874).

The type catalogue of Zhu & al. (2002) is helpful for the identification and circumscription of many Central Asiatic *Oxytropis* species, but after extensive studies of the material preserved in some large, mainly European herbaria, it seems to us that many of the published species are insufficiently distinct from each other. Many Tibetan so-called 'species' are apparently only known from few findings, and, suspiciously often so, only from the type. A realistic number of 'good' species for the Tibetan Plateau and the Himalayas may range around only 30-40, most of them having wide geographical ranges. *O. sericopetala* C. E. C. Fisch., a very conspicuous species of sand dunes along the middle Tsangpo Valley near Lhasa, not closely related to our new species, is one of very few local endemics. The Himalayas, in general, are relatively poor in *Oxytropis* species. Flora of Bhutan (Grierson & Long 1987) treats a mere four species (a few more are to be added). The relatively highest species diversity within *Oxytropis* concentrates obviously in the drier areas to the northwest (Pamir, Karakorum) and in the NE Tibetan Plateau (Qinghai), adjacent to or contiguous with the probably richest representation of the genus in N Central Asia and the Mongolian Plateau.

Similarly, the number of published species in the Irano-Turanian flora, including part of (former Soviet) Middle Asia, appears much too high. From own ongoing studies into the type material of *Oxytropis* species described in, or in relation with, Flora Iranica (Vassilczenko 1984, Rechinger 1984), it seems that a 'new species syndrome' (Fraser-Jenkins 1997) has prevailed.

Oxytropis iridum belongs to *Oxytropis* subg. *Oxytropis,* which is characterised by eseptate legumes. Its putative allies *O. deflexa* and *O. mollis,* alongside with the widespread *O. lapponica* (Wahlenb.) Gay, are usually considered as members of *O.* sect. *Mesogaea* Bunge. However, this section is defined by little more than the (potential) development of a stem, a character hardly suited for the delimitation of a section.

The vegetative characters that distinguish *Oxytropis iridum* from *O. deflexa*, i.e. a more pronounced woody caudex, longer scapes and a tendency to produce a stem (see Table 1), are to some degree ecologically determined. However, in contrast to the new species, *O. deflexa* seems generally to be a short-lived plant, also with some tendency to colonize ruderal habitats at high altitudes. The distribution of *O. deflexa* in Tibet is insufficiently known, though apparently scattered or disjunct and exclusive to *O. iridum* (Fig. 3). *O. lapponica* and *O. deflexa* are the only species of the genus that occur both in Central Asia/Tibet and North America.

While a close relationship of *Oxytropis iridum* and *O. mollis* is very likely, their geographical ranges do not seem to overlap. *O. mollis* is restricted to the (outer) W Himalayas from Chitral to Himachal Pradesh (Fig. 3), whereas we could not confirm any records of *O. mollis* from Uttaranchal, Nepal or eastwards. However, unresolved specimens or populations, previously assigned to this species, remain from the inner, far W Himalayas (S Karakorum and Ladakh). To some part, these plants comply with *O. thomsonii* Bunge, which, in turn, may represent robust forms of *O. mollis,* an indefinite hybrid or even a mixed collection. Another variable and poorly understood species of W High Asia is *O. humifusa* Kar. & Kir. To this species, actually the majority of specimens cited for *O. mollis* from the Karakorum by Hartmann (1966, 1968, 1972) belongs. In the same limited region, further ambiguities remain with the delimitation of *O. mollis, O. lapponica, O. lehmannii* Bunge and possibly other species. In contrast, and throughout the south side of the Himalaya main range in Pakistan and NW India, *O. mollis* is perfectly distinctive by its large flowers and its thick, underground-branching pleiocorm and not even accompanied by similar species in this area.

On account of gross morphology and phytogeography, a sister-relationship of *Oxytropis deflexa* and *O. iridum* is possible. The general composition of the Inner E Himalayan flora combines elements of two very different floristic areas: the moderately species-rich, though relatively rich in endemics, semi-arid part of SE Tibet (Lhasa-Tsangpo Basin) to the north and the species-rich humid E Himalaya to the south. The Lhasa-Tsangpo Basin is a rather well-defined phytogeographical entity with a distinctive flora (*Artemisia younghusbandii* Pamp., *Carex praeclara* Nelmes, *Festuca nepalica* Alexeev, *Oxytropis sericopetala* C. E. C. Fisch., *Rhodiola prainii* (R.-Hamet) Ohba*, Rheum globulosum* Gagé, among many other more or less endemic species). Geographically, this region is sharply delimited, at least to the north (Nyainqentangula Shan) and to the east (Kongbo/Tsangpo bend), but rather contiguous to the upper headwaters of the Inner Himalayan valleys draining to the south, from N Central Nepal to Assam. Many species, such as *Leontotopodium stracheyi* Hemsley, *Codonopsis vinciflora* Kom.*, Juniperus tibetica* Kom., *Pedi-*

cularis alashanica Maxim., indicate a closer phytogeographical relationship between the floras of the Lhasa-Tsangpo Basin and of Kham or E Tibet, i.e. the moderately dry area around the upper reaches of the Salween, Mekong and Changjiang rivers. Although the Lhasa-Tsangpo Basin is also home to scattered, and possibly anthropogeneously fragmented juniper groves and smaller forests (Miehe & al. 2000; *Juniperus convallium* Rehder & Wilson, *J. tibetica* Kom.), trees of any description are generally rare, as are probably also the vast majority of genuine floristic elements from the humid E Himalaya (*Betula utilis* D. Don, *Rhododendron* spp.). *Oxytropis deflexa,* however, seems to have only been found in the even colder high altitude areas of the Tibetan Plateau to the west and north of the Lhasa-Tsangpo Basin, well beyond the (potentially) forested area.

Besides more or less xerophytic species characteristic to the Lhasa-Tsangpo Basin, floristic elements of the humid E Himalaya also abound at or near the sites where *Oxytropis iridum* has been found. Therefore, the presently known distribution of the new species, in a more or less linear stretch of land, strictly aligned to an obviously steep climatic gradient along the crest line of the E Himalaya, does not seem an improbable phytogeographical pattern. A similar pattern, i.e. a putatively continuous distribution or migration path along the north side of the E Himalaya, has been proposed for *Fragaria tibetica* Staudt & Dickoré (2001). Almost linear distributions of species as determined by the orographical structure and/or climatic gradients are a generally common feature throughout the Himalayan flora. From this perspective, a possible closer relationship between the (S)W Himalayan *O. mollis* and the (N)E Himalayan *O. iridum,* although obviously widely disjunct, can also not be ruled out.

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Addresses of the authors:

Dr Wolf Bernhard Dickoré, Albrecht von Haller Institute of Plant Sciences, Dept. of Vegetation Analysis and Phytodiversity, University of Göttingen, Untere Karspüle 2, D-37073 Göttingen, Germany; e-mail: bernhard.dickore@gmx.de

Professor Dr Monika Kriechbaum, Centre for Environmental Studies and Nature Conservation, Dept. of Integrative Biology, University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, A-1180 Vienna, Austria; e-mail: monika.kriechbaum@boku.ac.at