

## **A contribution to the vascular plant flora of Lower Ladakh (Jammu & Kashmir, India)**

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LEOŠ KLIMEŠ &amp; BERNHARD DICKORÉ

## **A contribution to the vascular plant flora of Lower Ladakh (Jammu & Kashmir, India)**

### **Abstract**

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A list of 355 vascular plants, including 324 indigenous, naturalized or escaping and 31 cultivated species, is provided for the Dha-Hanu area, Lower Ladakh (Jammu & Kashmir, India). Previous floristic records from this remote high mountain area along the northern borders of India and Pakistan are scarce, but of the 45 species reported in literature 25 were not confirmed during the present study. Field work covered an altitudinal segment between c. 2750 and 4100 m along a section of the Indus valley from Khalsi to near the border with Pakistan. 18 species are new records to the flora of Ladakh. The phytogeographical significance of the study area is discussed, with a view of possible sampling artefacts due to the political border situation, while also indicating prominent floristic gradients.

### **Introduction**

Ladakh or 'Little Tibet' encompasses a large tract of high mountains along the upper Indus river (Jammu & Kashmir, India), north of the main range of the West Himalaya. Comprising part of the Karakorum Mountains to the north and west, and the western margin of the Tibetan Plateau, Ladakh is evidently sheltered from precipitation almost throughout its extensive relief. The peculiar, though species-poor desert and high altitude flora of Ladakh has attracted the attention of botanists since the second half of the 19th century (Moorcroft & Trebeck 1841, Thomson 1852, Schlagintweit & al. 1861-66). Presently sandwiched between the borders of Pakistan (Northern Areas) and China (Xinjiang and Tibet/Xizang), Ladakh remained difficult to access, both on account of its physical geography and on strategic and political grounds. Until recently many parts of the region have remained completely closed to foreigners. Floristic knowledge of Ladakh is accordingly still very patchy.

The present paper focuses on the flora of the Dha-Hanu region, the lowest part of the Indus valley inside India (Lower Ladakh). This valley section, between Khalsi where the main Kashmir (Kargil – Leh) road leaves the river and the border of Pakistan ('line of control'), has apparently been bypassed by most botanical explorations, and we have been able to find previous

reports of only about 45 species of vascular plants. During August 2002, the first author had the opportunity to visit Lower Ladakh, including areas close to the border with Pakistan, as well as a stretch along the Indus river of about 45 km. We report here a complete list of vascular plants collected or recorded on this occasion. Special attention was paid to species not previously reported from or regularly found in central Ladakh, and possibly reaching into the study area from the lower Indus valley of Pakistan (Northern Areas, Skardu).

## Study area

The study area (Fig. 1) encompasses the SE-NW extending section of the Indus valley between Khalsi (3050 m, 34°19'N, 77°9'E) to approximately 20 km from the border with Pakistan, covering an area of about 400 km<sup>2</sup>. The study area comprises the northwesternmost part of the 'Leh' section of the S Karakorum sensu Dickoré (1995). Field work was conducted along the road leading on the right bank of the Indus from Khalsi to Batalik (75 km) down to Dha (2750 m, 34°37'N, 76°29'E), 46 km NW of Khalsi. Besides the main valley bottom of the Indus, the lower and middle parts of two larger tributaries, Domkhar and Achinatang, were investigated up to about 4100 m (Fig. 2). The higher, alpine and subnival reaches of the Ladakh Range were inaccessible to us due to logistical constraints. The Indus valley within the study area is at places gorge-like and generally narrow as compared to its wide U-shaped section in central Ladakh, from above Khalsi through Leh to Upshi. Sediment deposits by the river are accordingly restricted to small areas. The tributaries generally comprise narrow rocky gorges in their lower parts, which widen in their upper parts (Hanu, Achinatang).

There is no permanent climate station available in the study area. However, the study area is situated halfway between Leh (3500 m) and Skardu (2295 m), approximately 100 km in either direction, for which climate data are available (Miehe & al. 2001). Moreover, the station Kargil (2682 m) is about 35 km due W of the study area, though outside the main Indus valley. Climate data from these stations indicate arid conditions. Annual precipitation at Leh is only 83 mm, at Skardu 208 mm and at Kargil 266 mm. The area is apparently only rarely affected by monsoonal precipitation, and most precipitation would be snow in winter and spring. Mean monthly temperatures vary between 6 and 10 °C (Leh 5.7 °C, Skardu 11.5 °C, Kargil 8.9 °C), with low winter minima (Leh -28.4 °C, Skardu -23.2 °C, Kargil -32.8 °C). Mean temperatures are below 0 °C from November to February or March. Summer temperatures are high, with maxima reported from Skardu only (41 °C).

Relatively high summer temperatures at the lower altitudes result in evaporation values much exceeding precipitation. Accordingly, the area is largely occupied by desert and semi-desert. The steep rocky lower slopes of the Indus valley and its tributaries are almost devoid of vegetation, unless irrigated or situated close to rivers. Smaller patches of wetlands, where groundwater bodies are present, are usually pronouncedly saline. Steppe vegetation and occasional steppe forest groves are found above c. 3500 m on the more gently sloping upper parts of the side valleys, and are usually intensely grazed by sheep and goats. Alpine grasslands can be expected at high altitudes.

Trees and larger shrubs are generally rare in the study area. Large *Salix* bushes (usually *S. sericocarpa*; probably both wild and cultivated) are found along rivers up to about 3900 m. Occasional, larger stands of *Juniperus semiglobosa* were observed from 3300 to 4160 m, and *Myricaria elegans* occurs up to approximately the same altitude. The Indus valley and side valleys within the study area are densely populated and virtually all appropriate sites up to about 4100 m are used for irrigated agriculture, with fields of barley and pea prevailing at the upper edge of cultivation.

## Material and methods

The annotated list of vascular plants of Lower Ladakh includes records from field collections and observation. The total number of records assembled is about 2030. The species list comprises ac-

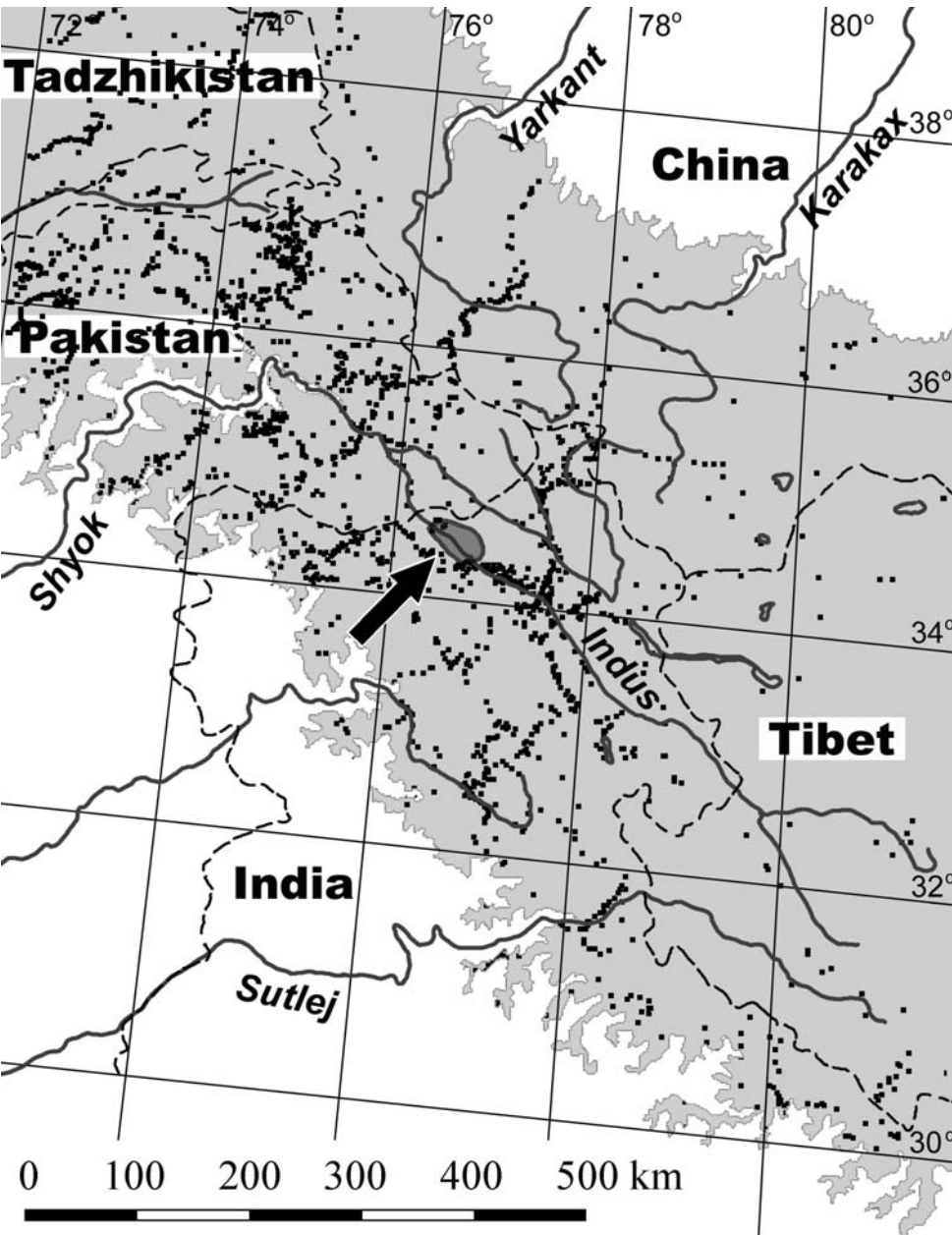


Fig. 1. Location of the study area (indicated by arrow) within NW Himalaya and Karakoram Mountains, and intensity of floristic research. Altitudes above 2000 m are shaded. Intensity of floristic research is indicated by dots, which correspond to individual or grouped records of vascular plants.

cepted taxon names, record locality and altitude. Data from the literature confirmed by the collections and observations of the first author are included, whereas 25 unconfirmed reports from the literature are given in a separate, second list. Annotations provide notes on habitats and, where

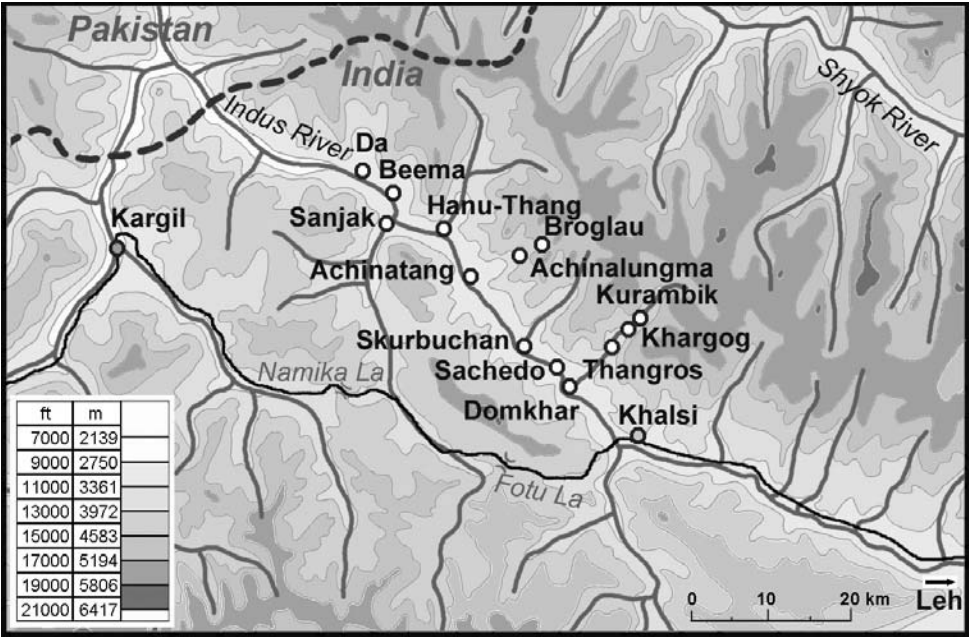


Fig. 2. The study area. Field study localities are denoted by empty circles, record localities out of the study area by shaded circles.

thought appropriate, brief discussions of taxonomy or distribution. Specimens collected by the first author [as indicated by the collecting number in square brackets] are deposited in the Herbarium of the Institute of Botany in Průhonice (PRA) near Prague. Species belonging to some taxonomically difficult groups, such as *Taraxacum* and *Euphrasia*, remained unidentified. New records to the flora of Ladakh are marked with an asterisk, species not or rarely escaping from cultivation are in square brackets.

As there is no consistent or recent catalogue of plant species for the area, nomenclature was based on Dickoré (1995) for monocots, with minor changes. For other groups the current nomenclature of the Flora Karakorumensis Database was basically adopted (Dickoré, unpubl.), with the intention to standardise diverging taxonomies of adjacent countries and floras. The majority of species delimitations and literature interpretation were also based on these sources. Additional specimen data used for distribution maps and for revealing individual distribution patterns were deliberately combined from the Flora Karakorumensis (B.D.) and Ladakh databases (L.K.). Altitudes given in the “List of localities” are rounded to nearest 10 m.

List of localities (arranged chronologically; see Fig. 2)

- 1: Domkhar (village): 3010-3050 m, 27.8.2002, 34°23.1'N, 76°45.8'E.
- 2: Domkhar (village): 3080-3110 m, 27.8.2002, 34°23.8'N, 76°46.6'E.
- 3: Domkhar Barma (village): 3200-3250 m, 27.8.2002, 34°24.4'N, 76°47.4'E.
- 4: Domkhar Yogma (village): 3300-3390 m, 27.8.2002, 34°25.1'N, 76°48.2'E.
- 5: above Domkhar Yogma (village): 3400 m, 27.8.2002, 34°25.2'N, 76°48.8'E.
- 6: Domkhar Yogma (village) upper part: 3350-3390 m, 28.8.2002, 34°25.1'N, 76°48.2'E.
- 7: Domkhar (village): 3450-3550 m, 28.8.2002, 34°25.6'N, 76°48.5'E.
- 8: below Thangros (village): 3600-3660 m, 28.8.2002, 34°26.0'N, 76°48.8'E.
- 9: Thangros (village) to Domkhar Gongma (village): 3650-3750 m, 28.8.2002, 34°26.5'N, 76°49.1'E.

- 10: above Domkhar Gongma (village): 3760-3810 m, 28.8.2002, 34°27.0'N, 76°49.4'E.
- 11: Domkhar Gongma (village) to Khargog (village): 3820-3920 m, 28.8.2002, 34°27.3'N, 76°50.0'E.
- 12: Khargog (village): 3930-4040 m, 28.8.2002, 34°27.5'N, 76°50.6'E.
- 13: Domkhar Yogma (village): 3350 m, 29.8.2002, 34°25.1'N, 76°48.2'E.
- 14: Domkhar Barma (village): 3110-3180 m, 29.8.2002, 34°24.4'N, 76°47.4'E.
- 15: Domkhar (village): 3080 m, 29.8.2002, 34°23.8'N, 76°46.6'E.
- 16: Domkhar (village) to Sachedo (village): 2950-3050 m, 29.8.2002, 34°25.4'N, 76°44.4'E.
- 17: Sachedo (village): 2930 m, 29.8.2002, 34°27.0'N, 76°42.3'E.
- 18: Skurbuchan (village): 2920 m, 29.8.2002, 34°28.6'N, 76°40.1'E.
- 19: Achinatang (village): 2890-2910 m, 29.8.2002, 34°30.3'N, 76°38.0'E.
- 20: Achinatang gorge: 2880-2980 m, 30.8.2002, 34°30.5'N, 76°38.1'E.
- 21: Achinatang valley: 3000-3090 m, 30.8.2002, 34°30.8'N, 76°38.4'E.
- 22: Achinatang valley: 3100-3150 m, 30.8.2002, 34°31.0'N, 76°38.9'E.
- 23: Achinatang valley: 3150-3190 m, 30.8.2002, 34°31.3'N, 76°39.2'E.
- 24: Achinatang valley: 3200-3290 m, 30.8.2002, 34°31.5'N, 76°39.7'E.
- 25: Achinatang valley: 3300-3390 m, 30.8.2002, 34°31.7'N, 76°39.9'E.
- 26: Achinatang valley: 3400-3490 m, 30.8.2002, 34°31.9'N, 76°40.3'E.
- 27: Achinalungma (village): 3500-3590 m, 30.8.2002, 34°32.0'N, 76°40.7'E.
- 28: Achinalungma (village): 3600-3690 m, 30.8.2002, 34°32.2'N, 76°41.0'E.
- 29: Achinatang valley above Achinalungma (village): 3700-3800 m, 30.8.2002, 34°32.4'N, 76°41.3'E.
- 30: Broglau (place): 3810-3920 m, 30.8.2002, 34°32.6'N, 76°41.5'E.
- 31: above Broglau (place): 3930-4040 m, 30.8.2002, 34°32.7'N, 76°42.1'E.
- 32: above Broglau (place): 4050-4160 m, 30.8.2002, 34°32.8'N, 76°42.6'E.
- 33: Achinatang (village): 2860 m, 31.8.2002, 34°30.3'N, 76°38.0'E.
- 34: Indus valley 1 km NW of Achinatang (village): 2850 m, 31.8.2002, 34°30.7'N, 76°37.6'E.
- 35: Hanu-Thang (village): 2810 m, 31.8.2002, 34°33.7'N, 76°35.8'E.
- 36: Kanutse (village): 2800 m, 31.8.2002, 34°34.4'N, 76°34.8'E.
- 37: Sanjak – opposite to village: 2790 m, 31.8.2002, 34°34.7'N, 76°33.4'E.
- 38: Beema – E part of village: 2780 m, 31.8.2002, 34°35.7'N, 76°32.2'E.
- 39: Beema – W part of village: 2780 m, 31.8.2002, 1.9.2002, 34°36.0'N, 76°31.0'E.
- 40: Beema (village) to Dha (village): 2760 m, 31.8.2002, 34°36.5'N, 76°30.2'E.
- 41: Beema (village) to Dha (village): 2750 m, 31.8.2002, 34°36.9'N, 76°29.4'E.
- 42: Dha – S part of village: 2750 m, 31.8.2002, 34°37.4'N, 76°28.6'E.
- 43: Dha – N part of village: 2770 m, 31.8.2002, 34°37.5'N, 76°28.7'E.

## List of the vascular plants of Lower Ladakh

### *Sphenopsida*

#### *Equisetaceae*

*Equisetum ramosissimum* Desf. – 5, 38. Wet ditches, irrigation canals with sparse vegetation.

### *Polypodiopsida*

#### *Cheilantheaceae*

*Cheilanthes grisea* Blauf. – 20 [2480], 39 [2562, 2834]. In rock crevices, shaded habitats. Previously reported from Mulpi to Kargil in Ladakh and S Hazara by Fraser-Jenkins (1992a). One individual [2562] was identified by Fraser-Jenkins as *C. leptolepis* Fras.-Jenk., also reported from Baltistan (Fraser-Jenkins 1992b). The probably small population of *C. grisea* in the Indus valley is apparently isolated.



**Athyriaceae**

*Deparia allantodioides* (Bedd.) Kato – 26 [2469]. Shaded habitats along rivers. Also reported from Ladakh by Fraser-Jenkins (1992a). Rarely found north of the Himalaya.

**Cystopteridaceae**

*Cystopteris dickieana* R. Sim – 1 [2336], 1 [2354], 5, 7, 9, 10, 16, 18, 20, 21, 22 [2493], 25, 30, 31, 32, 39, 43. In rocky crevices, leeward side of large stones and rocky blocks, synanthropic on stone walls. Identification of field records is tentative. *C. fragilis* (s.str.) may also occur, though is apparently rare in Ladakh and presently known only from altitudes above 4600 m.

\* *Gymnocarpium fedtschenkoanum* Pojark. – 39 [2553]. Wet shaded sites along rivers. According to Fraser-Jenkins (1992b) distributed from the Pamirs and E Afghanistan along the Himalaya to S Tibet. Stewart (1972 as “*Thelypteris remotipinnata*”) gives it from Kurram, Gilgit, Chitral, Baltistan, Hazara, Kashmir and Poonch.

**Coniferopsida****Cupressaceae**

*Juniperus semiglobosa* Regel – 7, 8, 11 [2374], 19, 25, 26, 27, 28, 29, 30, 31, 32, 39. Old trees usually in valley bottoms, younger trees and saplings found on steep rocky slopes and among boulders.

**Gnetopsida****Ephedraceae**

*Ephedra gerardiana* Wall. ex Stapf – 22, 23 [2499], 25, 26, 32. In rock crevices, on sterile gravel in river beds, stabilised slopes.

*Ephedra intermedia* Schrenk – 19, 33, 36, 40, 42. In rock crevices, sterile gravel in river beds.

*Ephedra regeliana* Florin – 17. Coarse sandy steppe, often among large boulders, on rocky and stony semi-deserts.

**Angiospermae****Dicotyledoneae****Amaranthaceae**

\*[*Amaranthus caudatus* L. – 13, 18, 24, 43. Ornamental, rarely weed. Nearest localities reported from Skardu, Pakistan (Stewart 1972).]

*Amaranthus graecizans* subsp. *sylvestris* (Vill.) Brenan – 43 [2535]. Weed in gardens and fields.

\* *Amaranthus powellii* S. Watson – 6, 21, 39, 42, 43. Weed of fields and field margins, along trails and roads, mesic to dry habitats.

**Apocynaceae**

*Apocynum venetum* L. – 34 [2546], 37. Dry deep screes at low altitudes, unstable slopes.

**Asclepiadaceae**

*Cynanchum acutum* L. – 17, 33, 34, 35 [2558], 36, 37, 39, 40, 42, 43. Unstable slopes, dry screes, at low altitudes only.

*Vincetoxicum hirundinaria* Medik. – 1 [2355], 16 [2466], 18, 20, 34, 35. Dry habitats along roads at low altitudes.

**Balsaminaceae**

\* *Impatiens brachycentra* Kar. & Kir. – 39, 43 [2522]. Shaded fresh habitats in villages, gardens, field margins, along canals. Nearest localities reported from Skardu, Pakistan, and from Kashmir (Stewart 1972, Nasir 1980).

*Impatiens thomsonii* Hook. f. – 18, 20, 21, 22, 25, 26, 30, 39. Fresh to wet river banks, canal banks, often shaded habitats.

**Boraginaceae**

*Anchusa arvensis* subsp. *orientalis* (L.) Nordh. – 2 [2353]. Weed in barley fields.

*Cynoglossum glochidiatum* Wall. ex Benth. – 3, 5, 6, 7, 8, 9, 10, 16, 18, 19, 21, 22, 26, 40. Mesic to dry field margins, along roads, on walls.

*Eritrichium fruticosum* Klotzsch – 11 [2431], 12 [2384]. Among stones, in coarse gravel and in rock crevices.

\* *Lappula tadshikorum* Popov – 12 [2435], 16 [2439]. Abandoned fields, road margins, along trails, disturbed steppe, among boulders. Popov (1951) reports this species from W Himalaya without precise locality. Among species with 2-3 rows of glochids on nutlets the most common species in Ladakh. Previously misidentified mostly for *L. barbata* (M. Bieb.) Gürke from which it differs by a style protruding above nutlets to c. 0.5 (not 1.5) mm.

*Lindelfia stylosa* (Kar. & Kir.) Brand – 10 [2379], 12, 31 [2510]. Mesic pastures, dry loamy, gravel and stony slopes. Reported from Ciorbat [Chorbat] Pass (Pampanini 1930 as "*L. angustifolia*").

*Mattiastrum himalayense* (Klotzsch) Brand – 9 [2395], 28 [2509]. Stabilised loamy slopes and screes.

*Microparacaryum intermedium* (Fresen.) Hilger & Podlech (*Mattiastrum tibeticum* C. B. Clarke) Brand – 6 [2434]. Disturbed road banks.

*Rochelia disperma* (L. f.) C. Koch – 30 [2518]. Disturbed open vegetation of abandoned fields. So far not reported from the Indus valley in India.

*Trigonotis tibetica* C. B. Clarke) I. M. Johnst. – 9 [2409, 2410], 12 [2409, 2410], 26, 29, 30, 31. Wet, temporarily flooded to mesic grasslands, among stones, on walls. Westernmost records so far.

**Campanulaceae**

\* *Campanula alsinoides* Hook. f. & Thomson – 19 [2448], 22, 24, 38, 39. On walls, disturbed shaded open vegetation of wet habitats. Nearest localities reported from Skardu, Pakistan (Stewart 1972).

*Campanula aristata* Wall. – 6, 9, 12. Among stones, eroded river banks.

*Campanula pallida* var. *tibetica* (Hook. f. & Thomson) Hara – 1, 2, 6, 7, 9, 16, 18, 20, 21, 39. In rock crevices, stabilised stony slopes, walls.

**Capparaceae**

*Capparis spinosa* L. – 1, 2, 4, 16, 18, 19, 33, 34 [2547], 35, 36, 37, 39, 40, 42. Singh & al. (2002) report it from Batalik (var. *spinosa*). Semi-deserts, disturbed dry road banks, dry stabilised screes.

**Caprifoliaceae**

*Lonicera asperifolia* (Decne.) Hook. f. & Thomson – 31, 32 [2471]. Among stones and on mesic river banks.

*Lonicera microphylla* Willd. ex Roem. & Schult. – 24 [2485]. Stabilised screes, dry river banks.

*Lonicera spinosa* (Decne.) Walp. – 11. Dry screes, gravel in river beds, among boulders. W edge of distribution.

**Caryophyllaceae**

*Arenaria serpyllifolia* L. – 1 [2357], 2, 7, 9, 10, 16, 19, 20, 21, 22, 23, 27, 31, 34, 42. Disturbed mesic to dry open habitats, field margins, along roads, abandoned fields.

*Cerastium cerastioides* (L.) Britton – 32 [2505]. Among mosses in springs, flushes.

*Cerastium holosteoides* Fr. – 1 [2343], 9 [2422], 11, 12, 24, 26, 27. Disturbed habitats, field margins, pastures, grazed river banks, abandoned fields, gardens, along roads.

*Lepyrodiclis holosteoides* (C. A. Mey.) Fenzl ex Fisch. & C. A. Mey. – 1, 7, 10, 12, 16, 28. Weed in fields, rare on loamy river sediments and on walls.

*Minuartia biflora* L. – 32. Mesic stony pastures. Nearest localities reported from Dras (Stewart 1972) (Fig. 5d).

*Minuartia kashmirica* Mattf. – 31, 32 [2474]. Mesic habitats, in screes, among stones.



*Silene conoidea* L. – 2 [2352], 7 [2406]. Field margins, along roads, weed.

*Silene moorcroftiana* Wall. ex Benth. – 1 [2361], 5, 6, 7, 9, 10, 12, 28, 31, 32, 40. Dry habitats – screes, rocky crevices, walls.

*Silene nepalensis* Majumdar – 1 [2370], 7, 10, 16, 21, 24, 38. Mesic, often shaded habitats – on river banks, in *Salix* woods. So far not reported from the Indus valley in India.

*Stellaria depressa* Em. Schmid – 5, 7, 12, 31, 32. Stabilised screes, mesic to slightly wet grazed grasslands in river beds, slightly saline or fresh, loamy-sandy gentle slopes, on wet sand.

*Stellaria fontana* Popov (*S. graminea* auct. non L.) – 19 [2458], 23, 27. Mesic pastures, wet grasslands along rivers.

*Stellaria irrigua* Bunge (*S. subumbellata* Edgew.) – 6, 12 [2376], 30, 31, 32. Mesic to wet habitats; in open disturbed sites along small rivers, springs, wet emerged sandy sediments, wet river gravel.

*Stellaria media* (L.) Vill. – 1, 7, 10, 18, 19, 23, 25, 26, 27, 30. Weed in gardens, field margins, along walls, ditches. On fresh loamy soils.

*Stellaria monosperma* Buch.-Ham. ex D. Don – 30 [2498], 31. In mesic screes. Nearest localities reported from Dras (Stewart 1972), Zoji La (Singh & Gohil 1972) and Nubra (Naqshi & al. 1989). NE edge of distribution. Generally a species of moister areas, W Himalaya to Gilgit and Baltistan. Depauperate plants may superficially resemble in habit *Lepyrodiclis holosteoides*, with which it is often confused.

### **Chenopodiaceae**

[*Atriplex hortensis* L. – 35 [2554]. Rarely cultivated in gardens and escaping.]

\* *Atriplex schugnanica* Iljin – 16 [2465], 20, 22, 23 [2487], 34, 39, 42. Disturbed open habitats along roads. Nearest localities reported from Gilgit, Pakistan (Stewart 1972) (Fig. 5b).

*Axyris hybrida* L. – 9 [2386], 12 [2436], 26, 28, 29, 30, 31. Disturbed open vegetation of abandoned fields, along trails and roads, resting places of domestic animals.

*Chenopodium album* L. – 1, 2, 7, 9, 10, 12, 18, 19, 21, 22, 25, 26, 27, 29, 31, 34, 35, 38, 39 [2560], 41 [2523], 42. Gardens, fields, along trails and roads, resting places of domestic animals. ([LK 2523]: s.l.; leaves narrowly lanceolate, entire, plant 2.5 m high).

*Chenopodium botrys* L. – 1 [2360], 2, 5, 6, 8 [2403], 16, 18, 19, 20, 21, 22, 23, 25, 26, 27, 29, 30, 31, 34, 35, 36, 39, 40, 42. Weed in sandy barley fields, sandy river sediments, disturbed habitats along roads; coarse-grained sandy steppe, dry gravel in river beds, synantropic in villages, rare in deserts, field margins, requires open stands.

*Chenopodium nepalense* Colla – 6, 7, 9, 10, 12, 21, 39 [2561]. Weed in potato fields, along irrigation canals.

*Chenopodium pamiricum* Iljin – 12 [2383]. Disturbed places, resting places of domestic animals, dry coarse sandy sediments, steppe on gravel river terraces. Previously unknown from the area, probably confused with *C. karoii* in literature.

*Corispermum* sp. – 36 [2555]. Disturbed places along roads (Fig. 3). It differs from *C. tibeticum* Iljin and *C. korovinii* Iljin by the truncate to slightly notched apex of fruits and late flowering (September), from *C. ladakhianum* Grey-Wilson & Wadhwa by larger fruits.

*Halogeton tibeticus* Bunge (*H. kashmirianus* Grey-Wilson & Wadhwa) – 16 [2440], 34, 41. Deserts, synantropic along roads, rare on rocks and in mesic habitats. Plants with papillate stems and branches, and with tufts of hairs at leaf axils. This species may be conspecific, according to Grubov (2000), with *H. glomeratus* (M. Bieb.) C. A. Mey.

*Haloxylon thomsonii* Bunge ex Boiss. (*H. griffithii* auct. non Boiss.) – 5, 6, 16, 19, 20, 21, 24, 34, 36, 37, 40. Deserts, among boulders and on rocks, sunny dry screes, always very dry habitats. Reported from “towards Dha” [Dha] by Chaurasia & Singh (2001 as “*Arthrophyllum thomsonii*”). An endemic of the Gilgit-Hunza-Indus basin that should be kept distinct from *H. griffithii*, which occurs from Chitral westwards.

*Kochia prostrata* (L.) Schrad. – 12. Dry steppe, disturbed habitats along trails.

*Kochia stellaris* Moq. – 6, 8, 22, 26, 28, 30, 34. Disturbed road banks. Road and trail banks, disturbed steppe.

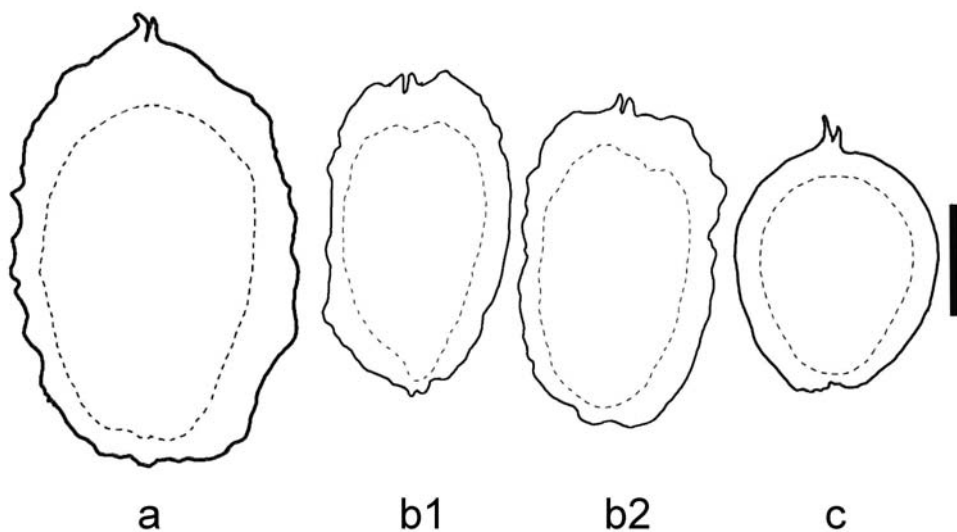


Fig. 3. Outlines of fruits of *Corispermum* sp. [(b1) and (b2); LK 2555], in comparison with *C. tibeticum* [(a), LK 588, Pilung La] and *C. ladakhianum* Grey-Wilson & Wadhwa [(c), LK 2829, Choglamsar village]. *Corispermum* sp. remains unidentified. – Scale bar = 1 mm.

*Krascheninnikovia ceratoides* (L.) Gueldenst. (s.str.) – 3, 4, 6, 20, 24, 27, 42 [2533]. Steppe, stabilised dry stony slopes. This and the following taxon seem fairly distinct and mutually exclusive through much of the Karakorum, although the nature of the taxa within the genus, their morphological definition and delimitation are apparently poorly understood. *K. ceratoides* s.str. is usually found at relatively low altitudes of the S and W Karakorum (Gilgit, Baltistan), often associated with steppe or steppe forest habitats, and occurs occasionally along the Indus to about Leh, but the identification of several specimens from this area remains doubtful.

*Krascheninnikovia pungens* (Pazij) Podlech – 9, 10, 12. Among boulders in dry rocky steppe, dry sand in disturbed habitats along roads, gravel river terraces, dry river beds. *K. pungens* is common in subalpine desert through the most arid parts of the central and N Karakorum.

*Salsola tragus* L. – 1, 16, 18, 34, 36, 37, 39, 42. Along roads and trails, field margins, sometimes slightly saline.

### Compositae

*Anaphalis nubigena* Hook. f. – 9 [2393]. On stabilised mesic and dry screes, in rock crevices.

*Anaphalis virgata* Thomson ex C. B. Clarke – 6, 8, 9, 16, 20, 22, 24, 28, 34, 39 [2565]. In rock crevices.

*Arctium lappa* L. – 16, 35, 38, 39. Waste places in villages, in ditches, along irrigation canals. Reported from Dha (Pampanini 1930).

*Artemisia brevifolia* Wall. ex DC. (*A. maritima* auct. non L.) – 5 [2364], 8, 9, 10, 12, 16, 20, 21, 23, 24 [2507], 25, 26, 27, 28, 29, 34. Steppes on stabilised slopes, often stony or with boulders, in rocky crevices.

*Artemisia compacta* Fisch. ex DC. – 32 [2506]. Mesic steppe at higher altitudes. An apparently poorly understood species of *A.* subg. *Seriphidium*, close to and not always unequivocally distinguished from *A. brevifolia*, at relatively high altitudes.

*Artemisia demissa* Krasch. (*A. stricta* Edgew. non B. Heyne ex DC.) – 7, 10, 12, 21, 24, 27, 31. Usually synanthropic or in disturbed places such as dry steppe on gravel river terraces, wet grasslands an river banks, abandoned fields, field margins, gardens, along trails and roads.

- Artemisia fragrans* Willd. – 1 [2362], 3, 5, 7, 8, 20, 21, 22, 34, 36, 37, 39, 42. Dry steppe, often stony or rocky. Another apparently poorly understood species of *A.* subg. *Seriphidium*, not always unequivocally distinguished from *A. brevifolia*, at relatively low altitudes.
- Artemisia macrocephala* Jacquem. ex Besser – 7, 9, 12, 16. Mesic to slightly wet, slightly saline or fresh disturbed habitats such as dry coarse sandy sediments in river beds, disturbed banks of water pools and their dried bottoms, road banks, pastures in river beds, abandoned fields, weed in gardens, in animal resting places, on field margins.
- Artemisia moorcroftiana* Wall. ex DC. – 3, 5, 7, 9, 10, 35. River bed sediments, ditches along roads, among stones in mesic habitats, field margins. W edge of distribution.
- Artemisia persica* Boiss. – 1 [2363]. Steppe at lower altitudes. E edge of general distribution.
- Artemisia santolinifolia* Turcz. ex Krasch. 5, 8, 9, 12, 30, 31, 32, 39. Steppe on stabilised slopes and gravel river terraces, on rocks, among stones and boulders, screes, rare in mesic habitats. Khaltse - Damkar [Domkhar] (Stewart 1972 as "*A. laciniata*").
- Artemisia scoparia* Waldst. & Kit. – 16 [2460], 34, 36, 37, 38. Disturbed road banks.
- Artemisia siversiana* Ehrh. ex Willd. – 1, 2, 7, 9, 16, 18, 19, 21, 22, 23, 37, 39, 42. Field margins, along roads and trails, open dry disturbed places in villages. Reported from Kaltse - Damkar [Domkhar] (*Schlagintweit 1116*, 15./19.7.1856) and Leh - Calatze - Domcar [Domkhar] (Pampanini 1930).
- Artemisia tournefortiana* Rechb. – 1, 13, 16, 19, 21, 22, 23, 30, 31, 39. Gravel screes, muddy stream sediments, in gravel of river beds, dry watersheds.
- Aster flaccidus* subsp. *glandulosus* (Keissl.) Onno – 10, 12 [2430]. Mesic to wet closed grasslands on river banks.
- [*Bidens biternata* (Lour.) Merrill & Sherff – 13, 16. Cultivated as a vegetable, sometimes escaping and spreading in ditches and along water canals.]
- Brachyactis roylei* (DC.) Wendelbo – 1, 5, 9, 10, 12, 20, 21, 25, 28, 29, 30, 31, 32. Dry to mesic habitats such as river beds, abandoned fields, waste places in villages, roads margins and road banks.
- [*Callistephus chinensis* Nees – 1, 16, 18, 19 [2447], 21, 25, 39, 40, 42. Ornamental, commonly cultivated in gardens, often escaping.]
- Chondrilla graminea* M. Bieb. – 39 [2548], 42. In rock crevices, dry rocky slopes. Nearest localities reported from Shyok valley (Pampanini 1930) and Nubra (Naqshi & 1989). Also at Dras and in Gilgit and Baltistan.
- Cichorium intybus* L. – 13 [2444]. Weed in fields. Nearest localities reported from Leh, India, and Shigar - Skardu (Pampanini 1930).
- Cirsium arvense* (L.) Scop. – 1, 10, 16, 19, 21, 23, 34, 37, 39, 40. Weed in corn fields, disturbed sandy river sediments, stony habitats and in gravel, sometimes slightly saline, unstable screes. Reported from Calatze - Domcar [Khalsi - Domkhar] (Pampanini 1930 as "*C. arvense* var. *neglectum*") and Dha (Pampanini 1930 as "*C. arvense* var. *incanum*").
- \* *Conyza canadensis* (L.) Cronquist – 40 [2525]. Synanthropic in villages, along roads and trails. Nearest localities reported from Skardu, Pakistan (Stewart 1972).
- [*Dahlia pinnata* Cav. – 1. Ornamental plant.]
- Echinops cornigerus* DC. – 2, 4, 8, 16, 18, 19, 20, 21, 24, 34, 37, 40. Sandy deserts, rare on rocks. Tolerates unstable sand surface, and in rock crevices.
- Erigeron multicaulis* Wall. ex DC. – 1, 2 [2335], 5, 16, 19, 20, 21, 35, 36, 39. Mesic to wet grasslands, in villages, along roads, disturbed open ground.
- Erigeron uniflorus* L. – 32 [2473]. In closed grasslands at higher altitudes.
- Filago paradoxa* Wagenitz – 19 [2456]. Dry disturbed open sites along roads. Nearest localities reported from Dras (Stewart 1972 as "*F. arvensis*").
- Galinsoga parviflora* Cav. – 1, 16, 18, 19, 35, 39, 42. Mesic, disturbed, often shaded habitats – in gardens and fields.
- [*Helianthus annuus* L. – 18, 35. Cultivated in gardens as ornamental plant.]
- Inula obtusifolia* A. Kern. – 4, 6, 8 [2412], 9, 20, 21, 22, 27, 34. Rocky crevices; rare on stony river beds and other stony slopes.

- Inula rhizocephala* Schrenk – 5, 23, 28. Mesic to wet closed grasslands, near springs, along rivers, river banks.
- Lactuca dissecta* D. Don – 1 [2365], 2, 7 [2433], 9, 10, 14, 16, 18, 19 [2455], 20, 21, 22, 23, 28, 38, 43. Mesic to wet ditches and along irrigation canals. Often shaded places.
- Lactuca orientalis* (Boiss.) Boiss. – 1 [2346], 4, 6, 7, 8, 9, 16, 18, 19, 20, 22, 23, 24, 26, 27, 34, 41. Steppe, rocky crevices, dry unstable scree, along roads.
- Lactuca rapunculoides* (DC.) C. B. Clarke – 6 [2429], 14, 19, 26. Shaded mesic sites along ditches and irrigation canals.
- [*Lactuca sativa* L. – 1, 7 [2421], 19, 27, 34, 43. Cultivated as a vegetable, escaping and spreading along irrigation canals.]
- Lactuca tatarica* (L.) C. A. Mey. – 1, 8, 12, 16, 18, 23, 26, 27, 35, 39, 41. Exposed loamy soils, often saline, disturbed sandy places along roads, rare in wet grasslands along rivers.
- Leontopodium ochroleucum* Beauv. – 5, 9, 12. Mesic to slightly wet slopes, slightly saline or fresh pastures in river beds, rare in mesic steppe, stabilised mesic to dry slopes and scree. Plants with leaves and bracts narrowly-ovate or lanceolate, relatively thinly hairy, usually not distinctly discoloured, stem base herbaceous, not elongating, without distinct sheaths of old leaf bases. Inflorescence congested, cypselas glabrous. Often misidentified as *L. leontopodium* (DC.) Hand.-Mazz. (leaves often broader, obovate-spathulate, indumentum rather denser but adaxially often glabrescent, discoloured, stem base often with sheathing remains of dark old leaves, somewhat lignified and somewhat elongating; inflorescence more diffuse, cypselas usually hairy).
- Leontopodium nanum* (Hook. f. & Thomson) Hand.-Mazz. – 12 [2378]. Mesic pastures drying in summer, short wet grasslands along rivers.
- Lipschitzia ceratocarpa* (Decne.) Kamelin (*Saussurea ceratocarpa* Decne.) – 1, 5, 6, 7, 9, 12, 14, 20, 21, 22, 23, 25, 26, 28, 29, 30, 31, 32. Wet to mesic grasslands along rivers, spring areas, gravel banks of streams. Reported from Dha (Pampanini 1930). Represented only by var. *depressa* (C. B. Clarke ex Hook. f.) ined., which may merit a higher taxonomic rank.
- Picris nuristanica* Bornm. – 1, 2, 16, 21, 25, 35, 38, 39. Mesic sites along canals, disturbed waste places in villages, in open stands along roads. So far not reported from the Indus valley in India.
- Psychrogeton andryaloides* (DC.) Novopokr. ex Krasch. – 31, 32. Mesic to dry stabilised slopes and scree.
- [*Rudbeckia laciniata* L. – 17. Ornamental plant cultivated in gardens.]
- Saussurea jacea* (Klotzsch) C. B. Clarke – 19 [2452]. Unstable slopes and steep scree.
- Scorzonera virgata* DC. – 10, 12. Dry slopes, steppe with boulders, stabilised stony slopes.
- Senecio dubitabilis* C. Jeffrey & Y. L. Chen – 3, 9, 31. Dry stony river beds, stony steppe, in gravel, among boulders, disturbed non-saline sites, river sediments in initial successional stages, rare in wet grasslands along rivers.
- Senecio krascheninnikovii* Schischk. – 1, 2, 5, 7, 9, 16, 21, 22, 23, 26, 27, 34. Mesic to dry open disturbed habitats, non-saline, waste sites in villages, field margins, gardens, weed in fields, along roads.
- Sonchus oleraceus* L. – 2, 16, 18, 19, 21, 22, 34, 35, 39, 42. Mesic to wet disturbed habitats along roads and in irrigation canals.
- [*Tagetes erecta* L. – 1, 16, 18, 19, 25. Ornamental plant, rarely escaping from gardens and window boxes.]
- Tanacetum fruticosum* Ledeb. – 1, 5, 9, 12, 20, 21, 26, 36. Stony steppe, unstable scree, gravel-sand semi-desert, in shrubs; rock crevices, disturbed dry sandy habitats, along roads, gravel river terraces.
- Tanacetum stoliczkae* (C. B. Clarke) R. Khan – 5 [2373], 8, 9, 28, 29. Stony slopes, among boulders, scree. Endemic to the Indus valley of Ladakh, closely related to *T. baltistanicum* Podlech (*T. gilgitii* R. Khan) from Gilgit, Hunza and Baltistan.
- Taraxacum* spp. – 1, 5, 7, 10, 11, 12, 16, 19, 20, 21, 25, 31, 32, 35, 39, 40. Several species, identification uncertain.

*Tricholepis tibetica* Hook. f. & Thomson – 40 [2538]. Dry open habitats among stones at lowest altitudes. So far not reported from the Indus valley in India. Endemic to the Gilgit-Hunza-Indus basin. (Fig. 4d).

*Waldheimia tridactylites* Kar. & Kir. – 31 [2511]. Mesic slopes, rock crevices, gravel in river beds, screes.

### **Convolvulaceae**

*Convolvulus arvensis* L. – 2, 18, 19, 39, 42. Dry to mesic non-saline habitats such as field margins, walls, waste places in villages, rare on rocks.

### **Crassulaceae**

*Hylotelephium ewersii* (Ledeb.) H. Ohba – 5, 7, 9, 12, 26, 28, 29, 31, 32. Mesic to wet grasslands, on river banks, walls, mesic screes.

*Rhodiola tibetica* (Hook. f. & Thomson) S. H. Fu – 12. Open vegetation such as gravel in river beds, mesic to wet screes, abandoned animal resting places.

### **Cruciferae**

*Arabidopsis thaliana* (L.) Heynh. – 9 [2425], 12, 42. Dry open habitats; abandoned fields, disturbed stony slopes, among stones.

*Arabis tibetica* Hook. f. & Thomson – 31 [2508]. Disturbed open vegetation on stabilised slopes, in rock crevices, among stones, dry to mesic screes.

[*Brassica oleracea* L. – 1, 7, 18, 19, 25. In all localities var. *capitata*, no. 7 also var. *botrytis*. Cultivated in gardens.]

*Brassica rapa* subsp. *campestris* (L.) Clapham – 2, 10, 39. Cultivated in gardens, often escaping from cultivation.

*Capsella bursa-pastoris* (L.) Medik. – 1, 3, 9, 10, 16, 20, 22, 23, 25, 29, 31, 39, 43. Weed in fields, waste places in villages, gardens, mesic trampled sites.

*Christolea crassifolia* Camb. – 1, 16. Stabilised dry stony slopes, unstable screes, rock crevices, gravel and sand semi-deserts.

*Conringia planisiliqua* Fisch. & C. A. Mey. – 1 [2368], 2, 10, 16. Weed in gardens, on fields, along roads and trails, waste sites in villages, abandoned fields.

*Crucihimalaya mollissima* (C. A. Mey.) Al-Shehbaz & al. – 8 [2424], 8 [2398], 9, 12, 14 [2442], 24, 28 [2472], 30, 31, 32. Weed of fields, field margins, abandoned fields, spreading along roads and trails, among stones of walls, dry to mesic grasslands.

*Descurainia sophia* (L.) Prantl – 10. Weed in barley and potato fields, waste places in villages, animal resting places, along trails and roads.

*Dontostemon glandulosus* (Kar. & Kir.) O. E. Schulz – 7, 9, 10, 12, 26, 31. Sandy steppe, disturbed open vegetation, trampled sites, sandy and loamy emergent bottoms.

*Draba altaica* (C. A. Mey.) Bunge – 8 [2423], 30, 31, 32. On stabilised dry stony slopes at higher altitudes, in rock crevices.

*Draba setosa* Royle – 32 [2475]. Gaps in grasslands or river banks. Reported from Chorbat P. (Jafri 1973; possibly on N ascent of the pass in Pakistan).

*Lepidium apetalum* Willd. – 1, 6, 7, 11, 20, 21, 23, 26, 27, 28, 34, 40, 43. Weed in fields, disturbed habitats along roads and trails, eutrophicated resting places of domestic animals, on coarse sand.

*Lepidium* cf. *latifolium* L. – 16, 19, 20, 35, 36, 39, 42. Deep dry screes, dumps, along road banks. *L. obtusum* Basiner, which differs from *L. latifolium* by sepals persistent in fruit and racemes not elongated in fruit, was only recently found in Ladakh. The above records may refer to both species.

*Malcolmia africana* (L.) R. Br. 20, 30 [2519]. Weed in barley fields, disturbed road banks with open vegetation.

*Matthiola chorassanica* Bunge ex Boiss. – 1, 4, 5, 9, 12, 17, 19, 20, 24, 34, 36, 39. Dry steppe, among boulders, on coarse sand, mesic pastures.

[*Raphanus sativus* L. – 16. Cultivated as a vegetable.]

*Sisymbrium brassiciforme* C. A. Mey. – 4, 7, 9, 11. Disturbed habitats along roads, dry screes, stabilised loamy slopes, dumps, weed in fields.

### **Cucurbitaceae**

[*Cucumis sativus* L. – 1. Cultivated as a vegetable.]

[*Cucurbita pepo* L. – 18, 19, 25, 39, 43.]

[*Cyclanthera pedata* Schrad. – 39 [2566]. Possibly only cultivated.]

### **Cuscutaceae**

\* *Cuscuta campestris* Yunck. – 42 [2531]. Parasite, on *Artemisia siversiana*. Nearest localities reported from Hazara and Ghizar, Pakistan (Rajput & Tahir 1997), nearest unpublished record is from Gilgit-Jutial (leg. Dickoré).

*Cuscuta planiflora* Ten. – 6, 9 [2408], 10, 12 [2437], 18, 19, 20, 26, 27, 30, 38 [2556], 39, 42. Parasite, on *Physochlaina praealta*, *Lonicera spinosa*, *Stachys tibetica*.

### **Eleagnaceae**

[*Elaeagnus igda* (Servett.) Tzvelev – 18, 19 [2454], 40. A cultivated form of *E. spinosa* L. (syn. *E. moorcroftii* Wall. ex Schltdl.).]

*Hippophae rhamnoides* subsp. *turkestanica* Rousi – 5, 18, 19, 22, 34. Along rivers, dry screes and loamy slopes, also cultivated.

### **Euphorbiaceae**

*Euphorbia hispida* Boiss. – 16 [2438]. Trampled road banks. Nearest localities reported from Leh (uncertain; Stewart 1972), Dras (Kachroo & al. 1977), Nubra (Naqshi & al. 1989) and Skardu, Pakistan (Radcliffe-Smith 1986).

*Euphorbia tibetica* Boiss. – 24, 28, 29. Dry steppe, among boulders, dry screes, on coarse sand, unstable loamy, gravel and sandy slopes, disturbed habitats along roads.

### **Fumariaceae**

*Corydalis flabellata* Edgew. – 1 [2344], 2, 4, 16, 18, 33. Singh & al. (2002) report it from Dumkhar [Domkhar]. Dry loamy slopes, stabilised screes.

*Hypecoum leptocarpum* Hook. f. & Thomson – 10, 26 [2521], 30, 31. Disturbed open vegetation of abandoned fields, spreading along roads, slightly saline sites, among large stones.

### **Gentianaceae**

*Comastoma pedunculatum* (Royle ex G. Don) Holub – 5, 7, 8, 9, 10, 11, 12, 30, 31, 32. Mesic to wet river banks, closed pastures along streams and water bodies, tolerates salty habitats.

*Gentiana leucomelaena* Maxim. – 7 [2420], 11, 30, 32. Mesic to slightly wet pastures, wet grasslands along rivers, grasslands in river beds, fresh or slightly saline. Only small-flowered plants, with corolla diameter 6-7 mm. Possibly deserving taxonomic recognition, likely at the variety level.

*Gentiana burkillii* Harry Sm. – 7, 9 [2413], 10, 12, 22 [2484], 30, 31, 32. Non-saline habitats – closed grasslands on river banks.

*Gentianopsis paludosa* (Munro ex Hook. f.) Ma – 1, 2, 5, 7, 9, 10, 12. Mesic to wet grasslands and pastures along river and irrigation canals.

*Gentianopsis vvedenskyi* (Grossh.) V. V. Pissjauk. – 6. Mesic and wet grasslands on river banks and on mesic slopes, drier sites at the foot of steppe slopes.

*Halenia elliptica* D. Don – 5 [2347], 7 [2417], 9, 10. Non-saline mesic to wet grasslands along rivers, spring areas. Western edge of distribution.

*Lomatogonium carinthiacum* (Wulfen) A. Br. – 9, 10, 12, 31. Non-saline open to closed grasslands along rivers.

*Lomatogonium thomsonii* (C. B. Clarke) Fernald – 5, 8, 10, 31. Mesic to wet habitats of river banks, wet gravel sediments in river beds with sparse vegetation, disturbed habitats, often saline.

*Swertia cordata* (G. Don) C. B. Clarke – 19 [2450]. Non-saline mesic to wet grasslands along rivers. Nearest localities reported from Dras (Stewart 1972).



**Geraniaceae**

*Erodium stephanianum* Willd. – 14 [2443]. Weed along roads, ditches, dump sites in villages.

*Geranium himalayense* Klotzsch ex Hofmeist. & al. – 9, 10, 12, 32 [2479]. Mesic to wet river banks, river beds, mesic gravel, rock crevices, among boulders.

*Geranium regelii* Nevski – 5 [2372], 7 [2428], 9 [2411], 19, 23, 29, 30 [2470], 31. Non-saline dry to mesic habitats in steppe, screes, open grasslands.

*Geranium sibiricum* L. – 1, 2, 16, 18, 19, 21, 22, 35, 39. Mesic non-saline habitats – road banks, on walls, among stones and in gravel.

**Grossulariaceae**

*Ribes orientale* Desf. – 3, 5, 7, 8, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 36, 39. Steppe, screes, in rocks crevices, river terraces.

**Juglandaceae**

[*Juglans regia* L. – 1, 2, 18, 19, 20, 40, 43.]

**Labiatae**

*Elsholtzia ciliata* (Thunb.) Hyl. – 1, 2, 18, 19 [2457], 20, 22, 39, 43. Mesic, often shaded, non-saline habitats such as river banks, *Salix* woods, stony habitats along rivers, gardens, dumps in villages.

*Elsholtzia densa* Benth. – 10 [2387], 12, 16. Weed in barley fields, field margins, dumps, along roads and irrigation canals.

*Elsholtzia eriostachya* Benth. – 12, 26, 30, 31. Open non-saline mesic to dry habitats such as disturbed steppe, coarse sandy river sediments, stream gravel, mesic to dry habitat.

*Lamium amplexicaule* L. – 1, 2, 6, 27. Mesic non-saline habitats such as weed in potato and barley fields, gardens, in ditches.

*Mentha royleana* Benth. – 1, 5, 19, 20, 21, 22, 23, 35, 39, 42. In ditches, wetlands, around springs, along irrigation canals.

*Nepeta discolor* Royle ex Benth. – 6, 7, 9, 10, 12, 30, 31, 32. Steppes, screes, stabilised slopes, sandy sediments, synanthropic along roads.

*Nepeta floccosa* Benth. – 3, 4, 7, 9, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 34. Unstable substrates; sandy non-saline deserts, rocky slopes.

*Nepeta glutinosa* Benth. – 30 [2486], 31, 32. Mesic non-saline habitats; gravel in river beds, stony slopes, along roads.

*Nepeta leucolaena* Benth. ex Hook. f. – 2, 5, 7, 10, 12, 26, 29, 39 [2524]. Dry steppe, among boulders, in rock crevices and on unstable screes.

*Perovskia abrotanoides* Kar. – 3, 5, 6, 17, 18, 19, 20, 20, 35, 36, 38, 39, 42. Dry non-saline habitats; among stones in steppe, in screes, in river beds.

*Stachys tibetica* Vatke – 1, 2, 4, 5, 7, 10, 12, 16, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 34, 36, 39, 40, 42. Dry steppe, among boulders and on rocks, dry unstable slopes and in screes, on coarse sand sediments. Reported from Kharbu Koma to Shaksi (SW Dah [Dha]) by Hedge 1990).

**Leguminosae**

*Astragalus oplites* Benth. ex R. Parker – 12, 31, 32. Stabilised slopes; dry steppe, among boulders, in screes.

*Astragalus strictus* Grah. ex Benth. – 9, 10, 12, 32. Mesic to wet, sandy to loamy, often slightly saline habitats – mesic pastures, wet grasslands along rivers, dry coarse sandy sediments and gravel in river beds, along road banks, disturbed stony steppes.

*Astragalus tecti-mundi* Freyn – 12 [2396]. Among stones, mesic, non-saline habitats.

*Chesneya popovii* Kamelin & Yakovlev – 8, 9, 20, 31, 34, 36, 40. Dry steppe, dry sandy soils, among boulders, on coarse sand. Described from Ladakh, more robust than *C. cuneata* (Benth.) Ali, calyx longer.

*Cicer microphyllum* Benth. – 6, 8, 9, 10, 12, 31, 32. Unstable dry gravel and screes, stabilised steppe slopes, along roads and on dumps.

- [*Lens culinaris* Medik. – 2 [2356]. Weed in barley fields, probably accidental occurrence.]
- Medicago falcata* L. – 31, 38. Road margins, weed in fields, disturbed pastures.
- Medicago lupulina* L. – 1, 2, 10, 16, 18, 19, 22, 23, 25, 27, 31, 35, 38, 42. Weed in barley fields, trampled grasslands in villages, disturbed pastures, ditches, along roads.
- Medicago sativa* L. – 2, 7, 10, 18, 19, 20, 21, 35, 39. Often escaping from cultivation.
- Medicago sativa* × *falcata* – 2, 16, 38, 39, 40, 42. Cultivated as fodder, often escaping. Reported from Dah [Dha] by Ali (1977).
- Melilotus officinalis* (L.) Desr. – 1, 9, 10, 16, 19, 21, 39, 42. Weed in barley fields, in gardens, along ditches, in gravel of river beds, along roads, dry dumpy places in villages.
- Oxytropis glabra* DC. – 6, 7, 10 [2391], 12 [2381]. Mesic grasslands and pastures, in mesic gravel, river banks, abandoned fields.
- Oxytropis hypoglottoides* (Baker) Ali – 12, 30, 31. Mesic to slightly wet, fresh or slightly saline habitats – pastures along rivers, gravel in river beds, irrigated banks of fields.
- Oxytropis lapponica* (Wahlenb.) Gay – 1 [2348], 5, 9, 10. Among stones of non-saline pastures along rivers.
- Oxytropis microphylla* (Pall.) DC. – 6, 10, 12. Sandy and stony steppe, among boulders, on gravel river terraces, dry stabilised slopes, dry gravel of river beds.
- Oxytropis pusilla* Bunge – 31, 32. In fresh pastures. An generally rare and local species concentrating in Ladakh/SW Tibet, W edge of general distribution (an isolated record from NE Afghanistan, Wakhan).
- Oxytropis tatarica* Camb. – 31. Steppe and sandy sites, dry stabilised slopes, sterile gravel of dry river beds.
- [*Phaseolus coccineus* L. – 1, 18, 39. Cultivated.]
- [*Pisum sativum* L. – 10, 12, 18. Escaping from cultivation.]
- Trifolium repens* L. – 40 [2539]. Mesic to wet ditches, along roads.
- [*Vicia faba* L. – 16, 18, 21. Cultivated.]

### Malvaceae

- Malva pamiroalaica* Iljin – 2, 13, 18, 19, 22 [2483], 23, 27. Weed in potato and corn fields, in gardens, trampled dumpy sites in villages, along roads, in ditches and along irrigation canals. Previously possibly misidentified as *M. parviflora*, see Stewart (1972).

### Moraceae

- [*Morus alba* L. – 1, 18 [2461], 19, 39. Probably cultivated only. Possibly natural stands are known from near Chilas, Pakistan.]

### Onagraceae

- \* *Epilobium cylindricum* D. Don – 1 [2371], 2, 5, 7, 8 [2426], 20 [2500, 2501], 23 [2500, 2501]. Previously reported from Kashmir and numerous localities in northern Pakistan (Raven 1962, Hoch & Raven 1981).
- Epilobium glaciale* P. H. Raven – 29 [2477]. Along streams.
- Epilobium royleanum* Hausskn. – 9 [2394], 18 [2449], 19, 21, 23, 25, 26 [2495], 34, 35 [2551], 39 [2541]. Eroded stream banks, emerged bottoms, springs, irrigation canals. Reported from Calatze - Domkar [Khalsi - Domkhar] (Pampanini 1930).
- Epilobium tibetanum* Hausskn. – 12 [2407]. Springs and flushes.

### Orobanchaceae

- Orobanche cernua* Loefl. – 7 [2414], 16, 43 [2534]. Parasitic on *Artemisia* species in steppe, field margins, gardens.

### Plantaginaceae

- Plantago depressa* Willd. – 1 [2350], 2, 5, 7, 9, 10, 12, 16, 18, 19, 20, 21, 22, 23, 25, 27, 29, 30, 31, 32, 38, 39, 43. Short pastures, trampled sites in villages, in ditches, along irrigation canals, river banks.

*Plantago major* L. – 1, 19 [2451], 34, 39, 40. In ditches, along roads in villages, in gardens. Nearest localities reported from Dras (Pilger 1937). Records from central Ladakh by Chaurasia & Singh (1996a) and Chaurasia & al. (1999) are uncertain.

### **Plumbaginaceae**

*Acantholimon lycopodioides* (Girard) Boiss. – 30, 31, 32. Steppe, among boulders, gravel in river beds, stabilised screes.

*Dictyolimon macrorrhabdos* (Boiss.) Rech. f. – 24, 26. Dry habitats; stony steppe. Reported from “Ladakh” based on Thomson (Hooker 1882, Pampanini 1930), exact locality not traced. A single locality known from central Ladakh (Gotsang Gompa; Hartmann 1995). Occasionally through the SW Karakorum in Gilgit and Baltistan (Stewart 1972).

### **Polygonaceae**

*Aconogonon tortuosum* (D. Don) Hara – 5, 7, 9, 12, 30, 31, 32. Dry unstable slopes and screes, among stones and boulders.

*Bistorta vivipara* Gray – 12. In mesic and moderately wet habitats, often saline; short closed grasslands, pastures on river beds.

*Fagopyrum tataricum* (L.) Gaertn. – 1, 2, 7, 10, 18, 19, 21, 22, 39, 40, 43. Often escaping from cultivation. Weed in fields, gardens, in ditches and irrigation canals, spreading along roads and trails.

*Koenigia islandica* L. – 1, 8, 9, 10, 12, 25, 26, 29, 30, 31, 32. Wet and waterlogged open habitats; closely to streams, often on loamy soils, springs, permanently wet screes, emerged sandy bottoms, fresh open wet sand.

*Oxyria digyna* (L.) Hill – 1, 2, 5, 7, 8, 9, 10, 16, 19, 20, 21, 22, 25, 29, 31, 32, 39, 43. On walls, in mesic to wet rock crevices, among stones and boulders near rivers, wet grasslands.

*Persicaria glacialis* (Meissn.) Hara – 9, 10, 12. Fresh open wet sand. Nearest localities reported from Dras (Stewart 1972), Pensi La (Chaurasia & Singh 1998) and Zoji La (Kachroo & al. 1977). An isolated locality has been reported from Ke La (about 110 km SEE from study area; Stewart 1972).

*Persicaria hydropiper* (L.) Delarbre – 34, 35, 39, 43 [2537]. Weed in mesic fields, irrigated habitats, abandoned fields, in ditches, canals, gardens.

*Persicaria lapathifolia* (L.) Delarbre – 1, 16, 18, 19, 43. Weed in mesic fields, irrigated habitats, abandoned fields, in ditches, canals, gardens.

*Persicaria nepalensis* (Meissn.) Miyabe – 1, 5, 7, 16, 18, 19, 21, 23, 28, 30, 34, 39. Non-saline mesic to moderately wet habitats; ditches, irrigation canals, depressions along rivers, also shaded habitats along walls.

*Polygonum arenastrum* Boreau – 19, 21, 23, 28 [2512], 42, 43. Trampled sites in villages, field margins, gardens, disturbed open pastures. Nearest localities reported from Kashmir and Astor, Pakistan (Qaiser 2001).

*Polygonum aviculare* L. – 7, 10 [2385], 18, 27, 31, 34. Dumps in villages, field margins, gardens, disturbed open pastures, often trampled.

*Polygonum cognatum* Meissn. – 9, 29, 31, 32. Mesic to wet, disturbed, often trampled habitats – pastures, wet open grasslands along rivers, on sand, often waterlogged or wet in spring and later drying out.

*Polygonum paronychioides* C. A. Mey. ex Hohen. – 8 [2397], 28 [2491], 32 [2494]. Dry to mesic abandoned fields, open trampled sites and pastures, mesic screes. Reported from Dah [Dha] (Qaiser 2001).

*Polygonum rotboelliioides* Jaub. & Spach – 8 [2399], 12 [2382], 25, 28, 29, 30, 31. Open vegetation, often trampled; dry disturbed pastures, coarse sandy steppe, wet grasslands along rivers, elevated gravel in river beds, sometimes weed in fields, spreading along roads, synanthropic.

*Rheum tibeticum* Maxim. ex Hook. f. – 30, 31. Gravel in river beds, stabilised steppe slopes.

*Rumex nepalensis* Spreng. – 20, 35, 39, 42. Abandoned animal resting places, in gardens, along ditches and walls, sometimes trampled.

*Rumex patientia* subsp. *tibeticus* (Rech. f.) Rech. f. – 1, 2, 5, 7, 8, 10, 12, 16, 18, 19, 22, 26, 27, 31, 42. Dha (Pampanini 1930 as “*R. orientalis*”; a record of “*R. domesticus*” from Dha by Schlagintweit, see Pampanini 1930, may refer to the same species). Qaiser (2001) reported Schlagintweit’s collection from SW Dah [Dha]. In dry to mesic habitats; weed in abandoned fields, field margins, in gardens, along roads, along irrigation canals, river sediment, gravel.

### **Primulaceae**

*Primula minutissima* Jacquem. ex Duby – 12 [2375], 32 [2497]. In gaps of wet non-saline river bank grasslands (Fig. 5c).

### **Ranunculaceae**

*Anemone rivularis* Buch.-Ham. – 1 [2349], 9, 10, 16, 18, 19. Shaded mesic to moderately wet sites; in *Salix* groves, open places along rivers, mesic to wet stabilised screes.

*Aquilegia fragrans* Benth. – 1, 9, 10 [2388], 12, 16, 18, 19, 39. Shaded mesic to moderately wet sites; in *Salix* groves, open places along rivers, mesic to wet stabilised screes. From Dhah [Dha] village reported by Chaurasia & Singh (2001).

*Clematis orientalis* L. – 1, 2, 5, 16, 18, 19, 21, 36, 39. Along rivers; screes, dumps, stony walls.

*Halerpestes sarmientosa* (Adams) Kom. & Aliss. – 1, 2, 5, 7, 11, 16, 19, 20, 23, 25, 30. Aquatic in stagnant water up to about 30 cm deep or in wet to drying habitats, sandy to loamy, often saline; ephemeral pools, emerged sandy bottoms, sandy river sediments, ditches, along irrigation canals, short pastures on river banks.

*Ranunculus brotherusii* Freyn – 6 [2427], 9, 12, 30 [2489], 32 [2488]. In non-saline short closed grasslands on banks of rivers and irrigation canals. A tentative identification. The taxonomy of the W Himalayan representatives and their possible relationship with *R. tanguticus* Maxim. is still uncertain.

*Ranunculus hirtellus* Royle – 1, 2 [2345], 16, 30. Mesic, non-saline open vegetation along rivers and irrigation canals, orchards, gardens, often shaded.

*Ranunculus longicaulis* C. A. Mey. – 10, 12. In non-saline wetlands, waterlogged or emergent with water level up to about 15 cm above soil surface; springs, marshes, disturbed river banks.

*Ranunculus* sp. – 32 [2490]. In gaps of short grasslands on river banks at higher altitudes.

*Thalictrum foetidum* L. – 1, 2, 7, 9 [2389], 10, 12, 16, 18, 19, 20, 21, 26, 27, 30, 39. On stony walls, in gravel, screes, among boulders (Fig. 5a).

### **Rhamnaceae**

*Rhamnus prostrata* Jacquem. ex R. Parker – 8, 24, 28, 30, 31, 32. In rock crevices, dry stony slopes, dry to mesic screes.

### **Rosaceae**

*Cotoneaster nummularius* Fisch. & C. A. Mey. – 42 [2529]. On dry rocky slopes. Nearest localities reported from Kargil (Kachroo & al. 1977) and Dras (Stewart 1972).

[*Malus domestica* Borkh. – 1, 19. Cultivated at lower altitudes.]

*Potentilla anserina* L. – 1, 5, 7, 9, 10, 12, 16, 19, 21, 23, 27, 30, 31. Open, disturbed, often saline habitats, nutrient-poor to eutrophicated, waterlogged to mesic; sandy river sediments, heavily grazed pastures, grasslands on river banks, dumps in villages, animal resting places, around houses, in gardens, along irrigation canals and in ditches.

*Potentilla bifurca* L. – 5, 7, 9, 10, 11, 12, 16, 18, 22, 23, 28, 29, 31. Dry, often sandy and disturbed habitats; on coarse sand, grazed steppe, sandy semideserts, among large boulders, on gravel river terraces, mesic pastures, drying in summer, on rocky slopes, on poor sand, abandoned fields, sandy road banks, less abundant in undisturbed steppes.

*Potentilla desertorum* Bunge – 32 [2514]. Steppe at higher altitudes. Nearest localities reported from Dras (Kachroo & al. 1977, Hartmann 1983).

*Potentilla multifida* L. – 1, 6, 7, 9, 10, 16, 18, 19, 21, 23, 27, 29, 31, 32, 39. Mesic grasslands, sometimes slightly saline, pastures drying out in summer, dry coarse sandy sediments in river beds, semi-deserts.

*Potentilla saundersiana* Royle – 10, 12, 31. Mesic stony slopes and steppe at higher altitudes.

*Potentilla venusta* Soják – 5 [2337], 9, 12, 26, 29, 31, 32. Stony slopes, stabilised screes, dry micro sites among boulders.

[*Prunus armeniaca* L. – 1, 2, 19, 21, 27, 35, 38, 42. Widely cultivated in gardens.]

*Rosa webbiana* Wall. ex Royle – 1, 5, 7, 10, 12, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 34, 37, 40, 42. Dry stony river beds, dry steppe with large boulders, mesic pastures, drying in summer, stony river terraces, dry stony slopes, in rock crevices.

*Sibbaldia cuneata* Hornem. ex Kuntze – 31 [2476], 32. Mesic to dry stony slopes and at higher altitudes.

### **Rubiaceae**

*Galium pauciflorum* Bunge – 7, 9, 12, 22, 26. Weed in fields and in villages, dump sites, ditches, gardens, rare in river beds among stones.

### **Salicaceae**

[*Populus nigra* L. – 1, 2, 16, 18, 19, 22, 34, 35, 42. Probably cultivated only.]

[*Populus pamirica* Kom. – 1, 7, 18, 19, 21, 26. Probably cultivated only.]

*Salix pycnostachya* Andersson – 1, 18, 42. Sometimes cultivated, possibly also autochthonous.

*Salix sericocarpa* Andersson – 1 [2338], 2342], 2 [2339], 7, 9, 10, 18, 19 [2445], 20, 22, 23, 24, 25, 26, 27, 30, 34, 36, 39, 42. Along rivers, in villages, near houses and in irrigated areas. Often planted, possibly also autochthonous.

### **Santalaceae**

*Thesium hookeri* Hendrych – 32 [2503]. Dry sites on stabilized screes, stony slopes, in gravel.

### **Scrophulariaceae**

[*Antirrhinum majus* L. – 43.]

*Euphrasia* spp. – 1 [2366, 2367], 5 [2366, 2367], 9, 10 [2392], 12. Short pastures along rivers.

*Lancea tibetica* Hook. f. & Thomson – 1, 5, 7, 8, 9, 10, 12, 21, 23, 27, 29, 30, 31, 32. Tumti [Timti?] La to Kharbu Koma (Pennell 1943). Wet to dry, in open vegetation, often saline or shaded; among boulders in steppe, mesic pastures drying in summer, wet grasslands along rivers. W edge of area.

\* *Leptorhabdos parviflora* Benth. – 35 [2557], 39, 42 [2527]. Mesic disturbed open sites in villages and along rivers. Nearest localities reported from Skardu, Pakistan (Stewart 1972) (Fig. 4c).

*Pedicularis cheilanthifolia* Schrenk ex Fisch. & C. A. Mey. – 9. Wet to dry sites, sometimes saline; river banks, pastures, disturbed river beds. Reported from Hanu Yagma via Handamir up Chorbit La (Pennell 1943, “*Pedicularis albida*”).

*Pedicularis longiflora* subsp. *tubiformis* (Klotzsch) Pennell – 5, 9, 10. Mesic to waterlogged, sometimes slightly saline habitats; marshes, springs, pastures, river banks, river beds. Usually in closed grasslands.

*Pedicularis punctata* Decne. – 5, 6 [2415], 7, 9, 10, 12, 16. Dah [Dha] and Kaltse to Damkhar (Pennell 1943). Wet grasslands on river banks, springs, non-saline.

*Pedicularis rhinanthoides* Schrenk ex Fisch. & C. A. Mey. – 1 [2369]. Non-saline slightly saline wetlands and mesic habitats; springs, marshes, river banks.

*Scrophularia nudata* Pennell – 9 [2390], 24 [2513], 32. Dry open habitats; steppe, screes, field margins.

*Veronica salina* Schur (*V. anagallis-aquatica* agg.) – 1 [2359], 2, 5, 7, 9, 10, 16, 18, 19, 22, 23, 34, 39, 43. Leh - Dha (Pampanini 1930 as “*V. anagallis* var. *pubescens*”, precise locality unknown). Wetlands with water level up to about 15 cm above the soil surface; springs, irrigation canals, artificial water pools. Differs from *V. anagallis-aquatica* L. by rounded capsules which are slightly longer than calyx.

*Veronica beccabunga* subsp. *muscosa* (Korsh.) Elenevsky – 12, 23, 29, 30. Wetlands with water level up to about 10 cm above the soil surface; moss springs, ditches, irrigation canals, artificial pools.

*Veronica biloba* L. – 30, 31, 32. Open vegetation on dry pastures and disturbed gentle slopes, often on sandy soils, synanthropic, eroded dry stream banks on loamy soils.

### **Solanaceae**

*Datura stramonium* L. – 35, 39, 42. Dumps and waste places in villages, ditches and road banks.

*Hyoscyamus pusillus* L. – 4 [2340], 16, 34, 42. Dry disturbed open sunny road banks, dumps.

*Lycium ruthenicum* Murray – 18. Dry stony slopes with sparse vegetation, screes, gravel in river beds.

*Lycopersicon esculentum* Mill. – 1, 18, 19, 35, 43. Cultivated as a vegetable, escaping from cultivation.

*Physochlaina praealta* (D. Don) Hook. f. – 3, 4, 5, 7, 9, 10, 12, 16, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 39. Screes and stabilised slopes, among stones in deserts, in settlements, often synanthropic, weed in barley fields, sometimes cultivated as a medicinal plant.

*Solanum nigrum* L. – 18, 20, 22, 25, 34, 35, 38, 39. Disturbed nutrient-rich sites in villages and along roads.

[*Solanum tuberosum* L. – 7, 10, 12, 18, 25. Cultivated as a vegetable, escaping from cultivation.]

*Solanum villosum* Mill. – 1, 16, 18, 21, 42. Mesic disturbed dumps, waste places in villages, ditches. No published records from the area, nearest unpublished localities are from central Ladakh, Nubra and Gilgit, Pakistan.

### **Tamaricaceae**

*Myricaria elegans* Royle – 2, 5, 8, 9, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 31, 32. Along rivers, on river banks, in gravel.

### **Umbelliferae**

*Carum carvi* L. – 1, 2, 5, 7, 9, 10, 12, 16, 19, 21, 24, 26, 30, 31, 43. Mesic pastures, wet grasslands along rivers, trampled grasslands in villages, dumps, along irrigation canals.

*Coriandrum sativum* L. – 19 [2446], 39, 43 [2530]. Escaping from cultivation, weed in fields.

*Daucus carota* L. – 8, 12, 39. Cultivated as a vegetable, escaping.

*Heracleum pinnatum* C. B. Clarke – 1, 2, 5, 7, 9, 10, 12, 16, 20, 21, 22, 26, 27, 39, 42. Stony river banks, screes, stony steppe and semi-desert slopes.

*Semenovia thomsonii* (C. B. Clarke) Manden. – 11, 12, 24, 29, 30. Mesic non-saline river sediments, unstable slopes, scree steppe, in rocks crevices.

*Seseli mucronatum* (Schrenk) Pimenov & Sdobnina – 1, 12, 16, 39. Mesic to wet pastures, gardens, ditches, irrigation canals.

*Sium medium* Fisch. & C. A. Mey. – 18, 19 [2462]. Wet sites; ditches, irrigation canals. Nearest localities reported from Dras (Singh & Gohil 1972, Stewart 1972, Dhar & Kachroo 1983).

### **Urticaceae**

*Parietaria judaica* L. – 35 [2542], 36. On stony walls. Nearest localities reported from Nubra (Naqshi & al. 1989) and Shyok (Pampanini 1930).

*Parietaria lusitanica* L. – 8 [2416], 21, 22, 27. On stony walls, shaded disturbed open vegetation on loamy soils. Nearest localities reported from Gilgit, Pakistan (Stewart 1972), an unpublished record is from Leh (leg. L. Klimeš). Kachroo & al. (1977) give it for Ladakh and Zaskar.

*Urtica hyperborea* Jacq. ex Wedd. – 25. Eutrophicated and disturbed sites; dry gravel of river beds, stony river terraces, in rock crevices, among stones and boulders, wet grasslands along rivers. Reported from Dha by Stewart (1972).

### **Violaceae**

\* *Viola kashmiriana* W. Becker – 35 [2543], 38, 39 [2563]. Mesic non-saline, often shaded sites at the lowest altitudes; open grasslands on steep loamy slopes, *Salix* bushes, among stones. Nearest localities reported from Shigar and Lower Shyok, Pakistan, and Kashmir (Stewart 1972).



**Vitaceae**

[*Vitis vinifera* L. – 15, 19, 35, 43.]

**Zygophyllaceae**

*Tribulus terrestris* L. – 3, 16, 18, 22, 23, 34, 35, 37, 42. Reported from Bema [Beema] by Singh & al. (2002). Sandy disturbed habitats with sparse or open vegetation, usually synanthropic.

**Monocotyledoneae****Alliaceae**

[*Allium cepa* L. – 7, 19, 25. Widely cultivated as a vegetable.]

*Allium przewalskianum* Regel (*A. stoliczkae* sensu Egorova (1977), non Dickoré) – 6 [2404], 7, 9. Field margins, dry to mesic stabilised scree, in sandy steppes among large boulders to stepic semideserts, often forming large patches.

[*Allium sativum* L. – 25. Cultivated as a vegetable.]

\* *Allium tuberosum* Röttler ex Spreng. – 18 [2467], 19, 35, 38 [2549], 39, 42. Shaded mesic to wet river banks, gardens. Nearest localities reported from Skardu and lower Shyok (Dickoré 1995).

**Cyperaceae**

*Blysmus compressus* (L.) Panz. ex Link – 6, 8, 10, 12, 39. Mesic pastures, sometimes drying out in summer, mesic to slightly wet heavily grazed grasslands in river beds, slightly saline or fresh habitats, saline grasslands, often near streams, on wet sandy river sediments.

*Carex microglochin* Wahlenb. – 12. Fresh wetlands, springs.

*Carex orbicularis* Boott – 12, 29, 30, 31. River banks, mesic to slightly wet heavily grazed slightly saline or fresh grasslands, wet grasslands along rivulets, springs.

*Carex sagaensis* Yen C. Yang – 32 [2492]. Heavily grazed river banks, forming dense turfs a few centimetres, curved scapes. W edge of distribution.

*Carex stenophylla* Wahlenb. – 12, 35. Coarse sand with steppe vegetation, dry sandy to loamy pastures, mesic pastures drying in summer.

*Cyperus squarrosus* L. – 7. Disturbed open wet flushes.

*Eleocharis quinqueflora* (F. X. Hartmann) O. Schwarz – 19, 35. Fresh-water banks along brooks, spring wetlands with water level of 3–5 cm of above soil surface, marshes.

*Isolepis setacea* (L.) R. Br. – 1, 9, 14, 20, 30, 38, 39. Weed in fields, wet disturbed open habitats along water-courses.

*Kobresia royleana* (Nees) Boeck. – 1, 2, 5, 7, 9, 10, 12, 16, 23, 32, 35. Mesic to slightly wet grasslands along streams, tolerates heavy grazing, slightly saline or fresh, mesic to dry gravel in river beds.

*Kobresia schoenoides* (C. A. Mey.) Steud. – 9, 10, 12, 31. Mesic and wet habitats of river banks and on stabilised slopes, often heavily grazed, slightly saline or fresh, sometimes dominant in wetlands.

**Gramineae**

*Agrostis gigantea* Roth – 5, 7, 8, 9, 10, 16, 19, 20, 21, 22, 23, 39, 42. Wet ditches, canals, mesic to wet pastures, springs.

*Agrostis vinealis* Schreb. – 12 [2377], 14 [2441], 24. Dry open grasslands.

\* *Aristida adscensionis* L. – 20 [2481]. Nearest localities reported from Skardu, Pakistan (Dickoré 1995) (Fig. 4a).

*Avena sativa* L. – 1, 16, 18, 19. Cultivated, often escaping.

*Bothriochloa ischaemum* (L.) Keng – 2, 5, 6, 16, 18, 19, 21, 35, 36, 38, 39, 40, 42. Disturbed habitats along the roads, rocky steppe, mesic to dry grasslands, often cultivated.

*Bromus pectinatus* Thunb. – 2, 7, 10, 12, 16, 39. Weed in barley fields, field margins, along irrigation canals and roads.

*Bromus tectorum* L. – 26 [2502], 28, 29, 30. Dry habitats on rocky slopes.

- Calamagrostis pseudophragmites* (Haller f.) Koeler – 2 [2351], 5, 19 [2459], 24, 39 [2540], 40. River beds, especially on sandy sediments and on slopes close to streams.
- Digitaria ischaemum* (Schreb.) Schreb. ex Muhl. – 16, 18 [2463], 35 [2545], 39, 40, 42. Often escaping from cultivation. Along roads, in field margins and gardens. Reported from Ladakh by Kachroo & al. (1977), without precise localities, and from Durbuk (Tanktse Vy.) by Chaurasia & Singh (1997). Nearest localities reported from lower Shyok, Pakistan (Dickoré 1995).
- \* *Digitaria sanguinalis* (L.) Scop. – 18 [2464]. Nearest localities reported from Skardu, Pakistan (Dickoré 1995).
- Elymus dahuricus* Turcz. ex Griseb. – 1, 16, 19, 20, 21, 22, 39, 43. In villages and along roads.
- Elymus jacquemontii* (Hook. f.) Tzvelev – 1, 5, 7, 9, 10, 16, 21, 22, 23, 25, 29, 31, 32. Screes, steppe, on gravel in river beds, stabilised slopes. rarely weed in fields.
- Elymus nutans* Griseb. – 1. Dry gravel in river beds.
- Elymus repens* (L.) Gould – 20. Synanthropic along roads.
- Elymus schrenkianus* (Fisch. & C. A. Mey.) Tzvelev – 12, 14, 39. Dry to mesic stable slopes, gravel deposits, stony habitats, mesic to slightly wet heavily grazed grasslands in river beds, slightly saline or fresh habitats.
- Elymus schugnanicus* (Nevski) Tzvelev – 31. Dry unstable slopes.
- \* *Enneapogon persicus* Boiss. – 34 [2559], 36 [2544], 39 [2552]. In rock crevices, dry habitats along roads. Nearest localities reported from Skardu, Pakistan (Dickoré 1995) (Fig. 4b).
- Eragrostis minor* Host – 6, 7, 16, 18, 19, 21, 34, 35, 39, 42. On sandy soils, along roads, in field margins, weed in fields, in villages.
- Eremopoa altaica* (Trin.) Roshev. – 7, 9, 10, 21. Dry to mesic disturbed habitats with open vegetation.
- Festuca albaica* Drobow – 32 [2468], 32 [2841]. Steppe to mesic grasslands at higher altitudes.
- Festuca rubra* subsp. *rubra* L. – 8, 9, 10, 12 [2419], 30, 31, 32. Mesic to slightly wet grazed grasslands in river beds, closed grasslands of river banks, slightly saline or fresh habitats, springs.
- Hordeum vulgare* L. – 7, 10, 24. Widely cultivated, often escaping.
- Leymus secalinus* (Georgi) Tzvelev – 9, 10, 12, 30. Sandy river sediments, gravel sands, abandoned fields.
- Melica persica* Kunth – 6, 7, 8, 9, 19, 24, 28, 29. Disturbed dry sand habitats along roads, dry steppe with large boulders, screes, gravel.
- \* *Muhlenbergia huegelii* Trin. – 39 [2550], 42. Nearest localities reported from Skardu, Pakistan (Dickoré 1995).
- Pennisetum flaccidum* Griseb. – 2, 5, 7, 9, 10, 21, 27, 43 [2536]. Dry steppe with large boulders, on sand and sandy semideserts, along roads, in human-disturbed habitats, in rock crevices, weed in fields, tolerates flooding, very broad ecological amplitude. Reported from Dah [Dha], right side of the Indus valley. (Dickoré 1995).
- Pennisetum orientale* Rich. – 42 [2528]. Dry disturbed habitats along roads. Naqshi & al. 1989 list this species for Nubra (without precise locality), nearest localities have been reported from Skardu and lower Shyok, Pakistan (Dickoré 1995).
- Phragmites australis* (Cav.) Trin. ex Steud. – 34, 39. Wetlands, ditches, irrigation canals, weed in irrigated barley fields.
- Piptatherum gracile* Mez – 1 [2358], 2, 5, 6 [2432], 7, 9, 10, 12, 19, 20, 21, 23, 24, 25, 26, 27, 28, 31 [2516], 32, 38, 40 [2526], 42. Dry stony steppe, among boulders, screes, in rocks crevices, mesic pastures, steppe vegetation on stony slopes.
- Poa annua* L. – 1, 6, 10, 11, 18, 19, 21, 22, 23, 25, 27, 31, 39, 43. Wet to mesic habitats, banks of irrigation canals, gardens, along roads and trails, in disturbed open habitats in villages.
- Poa attenuata* Trin. – 9, 10, 31, 32. Dry to mesic non-saline habitats; steppe, rocks, among stones and boulders, screes and stabilised slopes, sterile gravel in river beds.
- Poa calliopsis* Litv. ex Ovcz. – 9, 30. River banks, mesic to wet often disturbed grasslands, pastures, along irrigation canals.
- Poa pratensis* L. subsp. *pratensis* – 16, 19.

- Poa pratensis* subsp. *pruinosa* (Korotky) Dickoré – 12, 30 [2520], 31. Open to closed grasslands on river banks, mesic gravel deposits.
- Poa sikkimensis* (Stapf) Bor – 11 [2380], 28 [2478], 32 [2515]. River banks, wet stony habitats, sometimes flooded, near springs. S Tibetan & Central Himalayan species, nearest localities reported from central Ladakh (Leh) (Dickoré 1995).
- Polypogon monspeliensis* (L.) Desf. – 1, 7, 9, 16, 18, 19, 20, 22, 23, 34. Open disturbed wet habitats along rivers, canals, ditches, weed in fields, synanthropic in villages and along roads.
- Schismus arabicus* Nees – 8 [2402], 22 [2496], 25, 28, 29, 40. Dry, sandy, often trampled habitats, along trails.
- [*Setaria italica* (L.) P. Beauv. – 35, 39, 40 [2532], 43.]
- Setaria viridis* (L.) P. Beauv. – 1, 2, 16, 18, 19, 21, 22, 34, 35, 38, 39, 42. Weed in fields, gardens, in mesic grasslands near villages, spreading along roads.
- Stipa brandisii* Mez – 39 [2564], 39 [2567]. Mesic to wet shaded habitats along rivers. Nearest localities reported from Dras, India, and Gilgit, Pakistan (Kachroo & al. 1977, Dickoré 1995). A record from Sabboo village (central Ladakh; Chaurasia & Singh 1996a as “*S. sibirica*”) is uncertain.
- Stipa caucasica* Schmalh. subsp. *caucasica* – 9, 10, 12. Semi-deserts, stony and rocky slopes, rare on pure sand.
- Stipa himalaica* Roshev. – 4, 6, 7, 9 [2418], 10, 19, 20, 24, 25, 27. Dry steppe with large boulders, in crevices of dry rocks.
- \* *Stipa jacquemontii* Jaub. & Spach – 25 [2482], 27 [2517]. Dry habitats on rocky slopes, rock crevices, steppes. Nearest localities reported from Gilgit, Pakistan, Kashmir and Lahaul (Dickoré 1995).
- Stipa koelzii* R. R. Stewart – 9, 10, 12. Mesic to dry grasslands on river banks, along irrigation canals. W limit of distribution.
- Stipa splendens* Trin. – 1, 12, 13, 16, 18, 19, 21, 33. Dry slopes with boulders, steppe, often stony habitats, also along roads, on river banks, in gardens. Reported from Kanu [? Kanutse] by Freitag (1985).
- Trisetum clarkei* (Hook. f.) R. R. Stewart – 32 [2504]. Mesic grasslands at higher altitudes. Nearest localities reported from Skardu, Pakistan, Kashmir (Dickoré 1995), Naqshi & al. (1989) give this species for Nubra. One isolated locality reported from central Ladakh (Laotse Pass to Kardong) (Dickoré 1995).
- Trisetum spicatum* (L.) K. Richt. – 6, 9, 10, 12. Along irrigation canals, in open plant communities on river banks, stabilised stony slopes and wind-exposed habitats, mesophilous to slightly wet heavily grazed grasslands in river beds, slightly saline or fresh.
- [*Zea mays* L. – 18, 35, 39. Cultivated in gardens.]

### *Iridaceae*

- Iris lactea* Pall. – 16, 19, 21. Mesic to wet habitats, banks of irrigation canals, in gardens, often synanthropic in villages, trampled sites.

### *Juncaceae*

- Juncus articulatus* L. – 5, 6, 35. Wetlands with water level permanently above the soil surface, springs, irrigation canals.
- Juncus bufonius* L. – 3, 7, 9, 20, 21, 23, 34, 35. Wet open habitats, often synanthropic, along irrigation canals, in field margins.
- Juncus himalensis* Klotzsch – 6, 9 [2401], 12. Usually solitary among stones in mesic habitats. Nearest localities reported from S Zaskar and Dras (Dickoré 1995), Chaurasia & Singh (1996b) name it for Panamik (Nubra), Kachroo & al. (1977) for Nubra.
- Juncus membranaceus* Royle ex D. Don – 8 [2400]. Slightly wet habitats with low-canopy vegetation.
- Juncus thomsonii* Buchenau – 9, 11, 12. Wet habitats with low-canopy vegetation, often disturbed, along rivers and irrigation canals, spring areas.

*Juncus turkestanicus* V. Krecz. & Gontsch. – 1 [2341], 9, 19 [2453]. Differs from *J. bufonius* L. by inflorescence composed of 2-6-flowered clusters (flowers not widely spaced).

### **Juncaginaceae**

*Triglochin palustre* L. – 1, 16. In marshes, spring areas and other shallow wetlands, in river beds, fresh to saline.

### **Orchidaceae**

*Herminium monorchis* (L.) R. Br. – 6 [2405], 7, 10, 12. Wet canopy low-growing grasslands, usually shaded.

### **Additional unconfirmed records from literature**

*Amberboa moschata* (L.) DC. – Calatze - Domcar (Pampanini 1930) [probably misidentification].

*Artemisia absinthium* L. – Kaltsa [Khalsi] to Damkar (right side of Indus valley) (Ghafoor 2003) [possibly misidentification].

*Asperugo procumbens* L. – Dhah [Dha] village (Chaurasia & Singh 2001).

*Bassia dasyphylla* (Fisch. & C. A. Mey.) Kuntze – Kaltse to Damkar [Khalsi - Domkhar] (right side of the Indus valley) (Freitag & al. 2001).

*Calendula arvensis* L. – Dha, Calatze - Domcar [Khalsi - Domkhar] (Pampanini 1930 as “*Calendula officinalis* var. *arvensis*”).

*Catabrosa aquatica* (L.) P. Beauv. – Dhah [Dha] village (Chaurasia & Singh 2001).

*Chrysanthemum coronarium* L. – Kaltse to Damkar (right side of the Indus valley) (Ghafoor 2003).

*Corydalis crassissima* Camb. – towards Dhah [Dha] (Chaurasia & Singh 2001; “*Corydalis crassissima*”).

*Fagopyrum dibotrys* (D. Don) Hara – Dha (Pampanini 1930) [probably misidentification].

*Fallopia convolvulus* (L.) Á. Löve – Dha (Pampanini 1930).

*Festuca olgae* (Regel) Krivot. – Kharbu Koma to Shaksi, SW of Dah [Dha] (Dickoré 1995).

*Geranium collinum* Stev. ex Willd. – Dha (Pampanini 1930; var. *glandulosum*).

*Lappula deflexa* (Wahlenb.) Garcke – Skirbichen [Skurbuchan] (Stewart 1972 as “*Hackelia deflexa*”) [probably misidentification].

*Lepidium capitatum* Hook. f. & Thomson – Kaltse - Damkar [Domkhar] (Jafri 1973).

*Neotorularia humilis* (C. A. Mey.) Hedge & J. Léonard – Batalik (Chaurasia & Singh 2001 as “*Arabidopsis humile*”).

*Nepeta laevigata* (D. Don) Hand.-Mazz. – Dhah [Dha] village (Chaurasia & Singh 2001 as “*Nepeta lavigata*”) [probably misidentification].

*Pedicularis roylei* Maxim. – Calatze - Donkar [Khalsi - Domkhar] (Pampanini 1930) [probably misidentification].

*Physalis alkekengi* L. – Dhah [Dha] village (Chaurasia & Singh 2001).

*Populus caspica* (Bornm.) Bornm. – Chorbat Pass foot (Pampanini 1930 as “*Populus alba* var. *nivea*”).

*Rumex sanguineus* L. – Calatze - Dambar [Khalsi - Domkhar] (Pampanini 1930; var. *viridis*) [probably misidentification].

*Rumex xschlagintweitii* Rech. f. (= *R. nepalensis* x *patientia* subsp. *tibeticus*) – Dha (Pampanini 1930, Rechinger 1933 as “*R. cordifolius* var. *laxiflorus*”).

*Saussurea thomsonii* C. B. Clarke – On way to Hanu village (Chaurasia & Singh 2001) [probably misidentification].

*Stipa orientalis* Trin. – SW of Dah [Dha], Kharbu Koma Shaksi (Cope 1982, Dickoré 1995).

*Taraxacum brevirostre* Hand.-Mazz. – Dha (Stewart 1972).

*Taraxacum indicum* H. Lindb. – Calatze - Domcar [Khalsi - Domkhar] (Pampanini 1930).

## Status of floristic research in Ladakh

Floristic knowledge of Ladakh is patchy due to difficult access and political constraints. Fig. 1 clearly shows that much of the collecting has been done along roads in broad valleys, with little effort being put into major mountain ranges and the narrow sections of Indus, Shyok and tributaries. While the lower and middle altitudes of central Ladakh, around the town of Leh, seem well covered (Dickoré 1995), the higher altitudes and most border areas remain poorly known. Large tracts of northern and eastern Ladakh have only recently, after some 70 years, been opened to foreigners. Of the border areas opened in the 1990s, the lower Indus valley seems to have received the least attention. Situated close to the 'line of control', which still comprises one of politically most sensitive regions in Asia, permission to enter Lower Ladakh depends on the current political situation and access is largely limited to the main valley. Not surprisingly, the largest proportion of historical specimens from the Dha-Hanu region seems to have been collected in 1856 by the Schlagintweit brothers, who crossed the Chorbat Pass [Ciorbat P.] (N of Hanu) into Dha [Da, Dah] and Domkhar [Damkar] on their way to Khalsi [Kaltse, Khaltse]. A few plants were collected by Meebold in 1905. Altogether, 45 species records, including several dubious ones, were compiled for Lower Ladakh from Pampanini (1930), Dickoré (1995), Flora of (West) Pakistan and recently published Indian papers.

## Species richness of Lower Ladakh

In addition to the 324 indigenous or naturalized species found in the field, we can safely add about a dozen reliable species records from the literature. Our species list could further be somewhat expanded if existing taxonomic problems were solved (in *Euphrasia*, *Taraxacum*). Moreover, the alpine areas, which would be expected to host a distinct flora relatively rich in species, were not covered by our study. As inferred from the flora of central Ladakh (Klimeš, unpubl.), an additional c. 25% of species were to be found only at higher altitudes than those studied. Therefore, we expect a total number of slightly more than 500 species for Lower Ladakh [approx. 400 km<sup>2</sup>]. Our study would thus occupy an intermediate position among related areas in the NW Himalayas and Karakorum (Dickoré & Miehe 2002, Wündisch & al. 2003, Miehe & al. 2002), which would also fit into the general precipitation gradient. Based on a transect analysis of the flora of the Karakorum mountains, Dickoré & Miehe (2002) placed our study area on the border between areas with species numbers of 200-500 and 500-1000 species per 10 000 km<sup>2</sup>. Our findings seem to be closer to these figures than to predictions of a 1000-1500 species zone, as indicated on the world map of biodiversity (Barthlott & al. 1999).

## Distribution patterns

The flora of Ladakh is basically Central Asian in its general aspect and phytogeographic affinities (Kachroo 1993, Dickoré 1995). However, numerous Tibetan (as a more specifically defined subgroup of the Central Asian) and Himalayan elements are also found, many of which reach their absolute limits of distribution in Ladakh. Species with wide geographical ranges dominate, and very few species could be classified as endemics (Dickoré 1995, Murti 2001). Throughout Ladakh, many distribution areas align with northwest to southeast-trending zones along the main orographic axes (Himalaya, Ladakh Range, Karakorum), which apparently mirror climatically relatively homogeneous areas (Dickoré 1995). Another important gradient seems to extend transversally along the course of the Indus valley, partially congruent with its increasing elevation, from Gilgit and Baltistan to Ladakh and Tibet. Accordingly, Ladakh is also a meeting ground of a depauperate W Himalayan forest flora including a notable proportion of Irano-Turanian elements and a rather distinctive Tibetan high-altitude flora extending into the area from the east. On any given spatial scale, altitude, aspect and precipitation form a complex system of perpendicularly crossed gradients, which is apparently reflected in local distribution patterns of species (Dickoré 1995, Klimeš 2003).



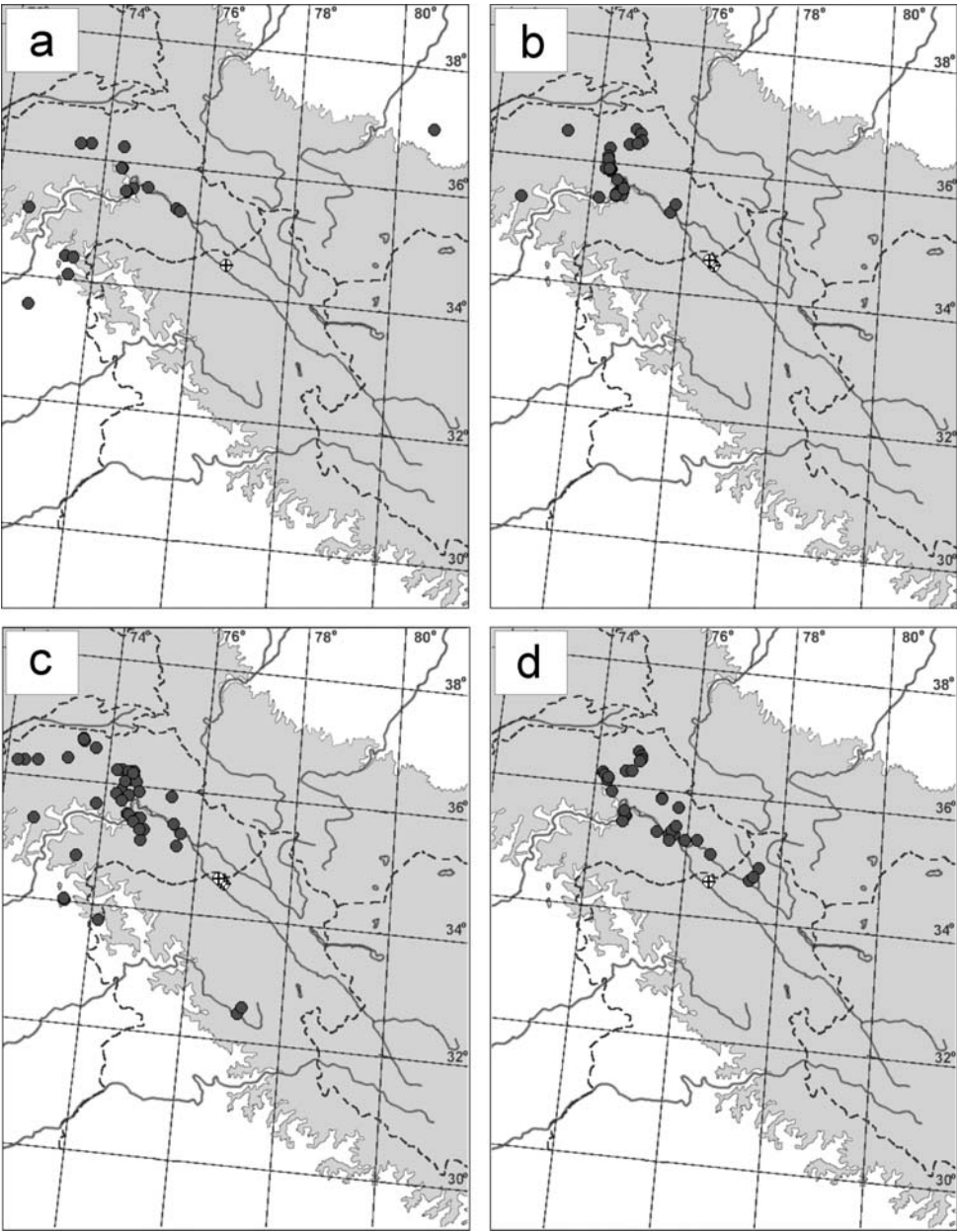


Fig. 4. Distribution of a: *Aristida adscensionis*; b: *Enneapogon persicus*; c: *Leptorhabdos parviflora* and d: *Tricholepis tibetica* in NW Himalayas and Karakorum Mountains. Full circles denote previously documented herbarium and literature records. Circles with a cross represent our records from Lower Ladakh.

A phytogeographical analysis of monocots in the Karakorum Mts by Dickoré (1995) has shown that transitions between some areas, as defined there, are unexpectedly sharp. For example, 106 species were reported along the Indian part of the Indus valley ('Leh'), and only 30 species in the parallel Shyok valley to the north (Indian part). Similarly, 111 species were found



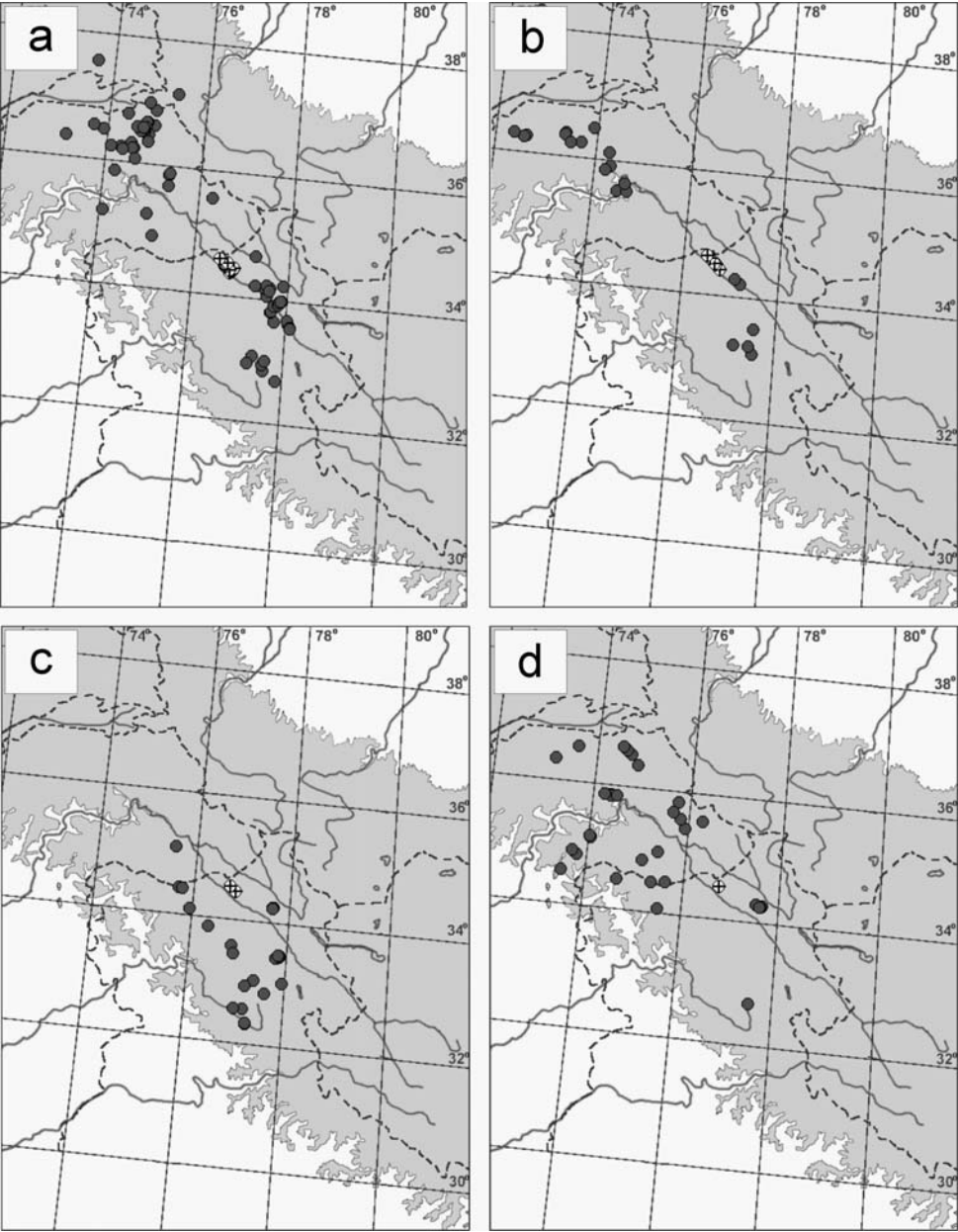


Fig. 5. Distribution of a: *Thalicttrum foetidum*; b: *Atriplex schugnanica*; c: *Primula minutissima* and d: *Minuartia biflora* in NW Himalayas and Karakorum Mountains. Full circles denote previously documented herbarium and literature records. Circles with a cross represent our records from Lower Ladakh.

along the uppermost Pakistani part of the Indus (‘Skardu’), whereas only 36 species have been reported from the neighbouring Lower Shyok valley. These patterns demonstrate to some degree sampling artefacts. With regard to species turnover, sampling artefacts are possibly also evident between the sections of the Indus on both sides of the ‘line of control’ (Skardu and Leh), with

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similar species numbers. Numerous species occurring along the Indus valley to Skardu were not reported across the border further to the southeast. A mirror pattern is also observable and several species apparently common along the broad upper section of the Indus were not previously observed along the narrow lower section between Marol and Khalsi, on either side of the border. Even more interesting is the high number of species widely distributed along the Indus valley between Gilgit and Leh, but apparently missing in the Marol-Khalsi section.

Our study revealed that an apparent distributional gap in many species along the Indus valley on either side of the 'line of control', of on average 200 km west-east extension, could be attributed to sampling artefacts, i.e. little collecting. Our study was able to fill this apparent gap on the Indian side, between Marol and Khalsi, for no fewer than 107 species. This improvement of our knowledge does not only concern plants occurring at lower altitudes (e.g. *Thalictrum foetidum* – Fig. 4a, *Atriplex schugnanica* – Fig. 4b), but also species of higher altitudes, normally occurring in the subalpine and alpine zones (e.g., *Primula minutissima* – Fig. 4c, *Minuartia biflora* – Fig. 4d, *Sibbaldia cuneata*, *Erigeron uniflorus*). The same continuous pattern can be demonstrated for various ecological groups such as weeds of arable land (*Anchusa arvensis*, *Schismus arabicus*, *Setaria viridis*) and of waste places (*Persicaria nepalensis*, *Poa annua*, *Polygonum cognatum*, *Rumex nepalensis*), wetland plants (*Carex microglochin*, *Equisetum ramosissimum*, *Juncus membranaceus* and *J. thomsonii*), steppe plants (*Arabidopsis thaliana*, *Rochelia disperma*, *Stipa caucasica* subsp. *caucasica*) and plants characteristic of dry (*Apocynum venetum*, *Agrostis vinealis*, *Campanula pallida*, *Capparis spinosa*) or wet scree and stony habitats (*Aquilegia fragrans*, *Myricaria elegans*, *Oxyria digyna*). However, in a few other species a distribution gap through Gilgit and Baltistan remains evident (*Artemisia persica*, *Nepeta floccosa*), and these species are apparently absent between Chitral/westernmost Gilgit and Ladakh.

A significant extension of their known distribution upstream along the Indus into Ladakh (southeast-wards) was found for 35 species. Some of these species were previously known from the Kargil basin (*Chondrilla graminea*, *Cotoneaster nummularius*, *Juncus himalensis*). Several other species were previously known only from the lower Indus in Pakistan and are therefore new to Ladakh. A smaller number of altogether 12 species demonstrate range extensions downstream along the Indus (to the northwest); the records from our study area comprise evidently outposts of a characteristic Tibetan high altitude flora such as *Carex sagaensis*, *Dontostemon glandulosus*, *Rhodiola tibetica*, *Stipa koelzii*. Most of these species are found from E Ladakh eastwards, through much of the Tibetan Plateau and more regularly downstream along the Indus only to around Leh. Some widespread weeds, previously reported from Kashmir (*Amaranthus graecizans*, *Conyza canadensis*) may demonstrate recent area expansions in the dry inner valleys. Most of our new findings must, however, rather be related to increased collecting effort. Several species found in the study area have rarely been recorded from Ladakh and their occurrence may thus be of some interest (e.g. *Artemisia compacta*, and some weeds such as *Cichorium intybus*, *Cyperus squarrosus*, *Datura stramonium*).

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