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# Taxonomic revision of Chenopodiaceae in Nepal

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## Abstract

A taxonomic revision of the family Chenopodiaceae in Nepal with new diagnostic keys, descriptions and detailed distribution patterns is here presented for the first time. 24 species from 13 genera are reported. The apophytes in Himalaya are found in both ruderal and segetal plant communities in contrast to Chenopodiaceae in temperate parts of Eurasia which prefer ruderal places only. The Himalaya and West Tibet are considered to be the regions with the greatest taxonomic diversity of native *Dysphania* in Eurasia. *Chenopodium perttii* is described as new for science, and its differences from other related taxa are described, including its unique minute-papillate (almost smooth when dry) pericarp. *C. bengalense* seems to be an older name for the taxa known as *C. giganteum* or *C. album* subsp. *amaranticolor*. The lectotypes of *Chenopodium giganteum, C. album* subsp. *yunnanense, C. aristatum* f. *muticum* (here synonymized with *Dysphania kitiae*) and *Microgynoecium tibeticum* are designated. Both lectotype and epitype for *Atriplex bengalensis* (basionym of *C. bengalense*), *C. giganteum* and the re-instated species *C. pallidum* are designated.

**Key words**: *Chenopodiaceae*, *Dysphania*, distribution, ecology, Himalaya, Nepal, new species, typification, taxonomic revision.

## Introduction

The family Chenopodiaceae Vent. comprises about 100 genera and approximately 1600 species distributed worldwide (Sukhorukov 2014) and it is a sister group to Amaranthaceae according to molecular investigations (Kadereit *et al.* 2003). Most of Chenopodiaceae are widespread in the semiarid and arid regions of the World. The Himalaya, especially the northern territories including NW India and Pakistan, is rich in Chenopodiaceae (Rechinger 1997, Klimeš & Dickoré 2005), but the number of the representatives decreases towards the south-east territories. In Bhutan, only eight species in the family were reported (Long 1984).

The revision of Chenopodiaceae in Nepal has not been carried out before now. In the first comprehensive account of the Eastern Himalaya (Bhutan, parts of India and Nepal) based on expeditions lasting several years, only two representatives [*Chenopodium album* Linnaeus (1753: 219) and *Dysphania ambrosioides* (Linnaeus 1753: 219) Mosyakin & Clemants (2002: 382) (sub *C. ambrosioides*)] were recorded (Hara 1966). The treatment of the entire family (14 species from 7 genera) was provided for Mustang Province in the mountainous Central Nepal (Yonekura 2008), as well as revised contributions relating to the complicated Himalayan and Tibetan species of the genera *Axyris* Linnaeus (1753: 979) (Sukhorukov 2011) and *Dysphania* Brown (1810: 411) (Sukhorukov 2012a, 2012b, 2014; Uotila 2013). The aim of the present study is a revision of the family in Nepal using recent and improved taxonomy and detailed distribution patterns.

## Material and Methods

The field investigations were carried out by the first author during 2005–2013 in many provinces of Nepal in all major parts of the country (West, Central and Eastern Nepal). The herbarium material is preserved in the herbaria B, BM,

E, G, MW, W (herbarium abbreviations according to Thiers 2008+). The revision of the material was undertaken at the same collections as well as in K, KATH, LE, PE, SHI, TUCH, WUK, XIA, and XJBI. The citation of specimens is given according to the subdivision of the country into the three major regions West, Central and Eastern Nepal (see Press *et al.* 2000), with further delimitation into zones and districts.

Prior to scanning electron microscopy (SEM) for investigation of the pericarp surface (one of the most valuable taxonomic characters), the material was dehydrated in aqueous ethyl alcohol solutions of increasing concentration, then in alcohol-acetone solutions and pure acetone. SEM observations were made with a JSM–6380 (JEOL Ltd., Japan) at 15 kV after critical-point drying and sputtercoating with gold-palladium. Non-dehydrated dry fruits were also used for SEM viewing for a comparison of pericarp structure. Carpological terms are according to Werker (1997).
Not all nomenclatural synonyms have been cited in the generic or species lists, and only the most important synonyms previously used in taxonomic treatments are given in the present article (see also Sukhorukov 2005, Heklau & Röser 2008, Fuentes-Bazan *et al.* 2012b, Sukhorukov 2014). Asterisks (*) following the chromosome numbers and herbaria indicate that the voucher specimens of the seeds investigated caryologically were collected in Nepal by the first author (A.S.) and deposited in the given herbarium.

Where not specially stated the generic and species descriptions are based on specimens of various origins, but the habitats and altitudes relate to populations growing in Nepal.

## Taxonomy and ecology

13 genera and 24 species of Chenopodiaceae were recorded. The richest genera are *Chenopodium* and *Dysphania* (6 and 5 species respectively). None of the species can be recommended to be included in IUCN Red List Category (IUCN 2010).

Only mountainous areas at elevations over 2000 m above sea level are to be considered as appropriate habitats for the native species in the family. In the tropical part of Nepal only several species were found, and they can be considered as alien [*Chenopodiastrum murale* (Linnaeus 1753: 219) Fuentes-Bazan *et al.* (2012b: 14), *Dysphania ambrosioides* (Linnaeus 1753: 219) Mosyakin & Clemants (2002: 382)] or widespread taxa with unclear origin [*Chenopodium album, C. ficifolium* Smith (1800: 276)]. Among the native species only *Krascheninnikovia ceratoides* (Linnaeus 1753: 979) Gueldenstaedt (1772: 555) grows in natural conditions (in hammada), the rest of them having a clear tendency to become established in disturbed areas. The primary habitats of *D. nepalensis* (Colla 1836: 25) Mosyakin & Clemants (2008: 428) and *D. neglecta* Sukhorukov (2014: 346) seem to be limestone hill slopes and river terraces, but the habitats of most populations are connected with disturbed places. In contrast to the Chenopodiaceae in temperate Eurasia that certainly prefer ruderal sites (roadsides, railways, etc.) when moving from native habitats (Sukhorukov 2014), the chenopodiaceous apophytes in Himalaya form both ruderal and segetal plant communities. The most common apophytes at elevations between 2000 and 3500 m where they are especially abundant are *Acroglochin chenopodioides* Moquin-Tandon (1840: 254), *Dysphania nepalensis* and (in West Nepal) *D. neglecta*. All *Chenopodium* species are found only in anthropogenic or semi-disturbed habitats. Although the Chenopodiaceae have been undercollected before now, it is possible to determine their main distribution patterns and frequencies on the basis of the observations and revised material.

## Key to the genera

The key does not include *Beta vulgaris* Linnaeus (1753: 222) and *Spinacia oleracea* Linnaeus (1753: 1027), sometimes (but not elsewhere) cultivated as vegetables without escaping.

1. Leaves flat; seeds with abundant perisperm; embryos horseshoe-shaped or annular … ..... 2
- Leaves subulate, apically with short mucro; seeds without perisperm; embryos spiral..... 13. *Kali*
2. Plant mostly covered with stellate hairs; flowers unisexual; male inflorescence terminal; female flowers located below in the axils of bracts …… ..... 3
- Plant glabrous or covered with simple, bladder (‘white meal’), glandular hairs or subsessile glands; flowers usually bisexual, very seldom unisexual but in this case both flower types in mixed inflorescence …… ..... 4
3. Subshrublet (in Nepal); female flowers without perianth, enclosed only by two bracts that are fused at least halfway, at fruiting slightly enlarged and covered with long simple and short-rayed stellate hairs ..... 10. *Krascheninnikovia*
- Annual; female flowers with free hyaline perianth segments, which are not enlarged, and covered with simple hairs ..... 9. *Axyris*

4. Hairs simple, easily visible to the naked eye, up to 5 mm long; perianth segments at fruiting with tubercles or horizontal wing-like projections ..... 12. *Bassia*
- Simple hairs short if present; no horizontal wing-like outgrowths on the foliar structures enveloping the fruit ……..... 5
5. Small high-mountain plant with basally branched procumbent stem; leaves short, up to 2 cm, entire; pericarp at least in the upper part of the fruit forms easily visible ear-like outgrowths ..... ..... 5. *Microgynoecium*
- At least lower leaves longer than 3 cm; pericarp smooth or papillate, without ear-like appendages ……..... 6
6. Tumble-weed, branches usually with acicular apices; leaves sessile or subsessile, cuneate, entire, mostly curved ventrally .. ..... ..... 8. *Teloxys*
- Leaves clearly short or long petiolate, at least lower leaves not entire ……..... 7
7. Plant aromatic; stem, leaves and perianth covered with short simple hairs, glandular hairs and yellow subsessile glands (with obscure stalks) ……..... ..... ..... 7. *Dysphania*
- Plant not strong smelling, glabrous or with bladder hairs or short and curved simple hairs……..... 8
8. Branches mostly with acicular apices; leaves glabrous or with simple short hairs; fruits dehiscent by a lid .....… 11. *Acroglochin*
- Branches without acicular apices; hairs if present of other shape; fruit indehiscent, or pericarp ruptures irregularly …… ..... 9
9. Plant forms two kinds of flowers (male and bisexual flowers surrounded by perianth of (4)5 segments, and female flowers supported only by a bract-like cover formed of two accrescent segments, which are connate only basally); seeds heteromorphic (black and mostly with horizontally oriented embryo, and yellow-brownish with vertical embryo); leaves ovoid or triangular, usually reddish ..... ..... 4. *Atriplex*
- Flowers bisexual, with perianth of 3–5 non-accrescent segments …… ..... 10
10. Plant with basal and cauline long-petiolate triangular leaves; perianth segments at fruiting red and fleshy; pericarp adhering to the seed coat; seeds oblong ..... ..... 6. *Blitum*
- Plant with only cauline leaves; perianth segments green or hyaline, not fleshy; pericarp separating from the seed or ruptured easily; seeds depressed-globular …… ..... 11
11. Plant prostrate or with ascending stems; leaves green above and grey beneath; perianth of 3–5 segments; seeds with both horizontal and vertical embryos on the same plant; pericarp smooth ..... 3. *Oxybasis*
- Plant with prominent erect stem; perianth of (4)5 segments; pericarp papillate (often reticulate or smooth when dry); seeds with horizontal embryo ……..... 12
12. Leaves slightly cordate at base; seed diameter 1.5–2 mm….....…..... 2. *Chenopodiastrum* (*C. badachschanicum*)
- Leaves cuneate or broadly truncate; seed diameter less than 1.5 mm ……..... 13
13. Ruderal dark-green plant at elevations up to 2000 m; inflorescence short (mostly up to 10 cm), leafy; seeds prominently keeled; pericarp reticulate when dry; leaves rhombic, dentate or erose-dentate ..... .. ..... 2. *Chenopodiastrum* (*C. murale*)
- Inflorescence mostly larger and often leafless; seeds without keel or with keel; leaves trilobate, dentate or entire ..... ..... ..... 1. *Chenopodium s.str.*

## Subfam. Chenopodioideae

## Tribe Chenopodieae

### 1. *Chenopodium* Linnaeus (1753: 218)

Type:—*Chenopodium album* Linnaeus (lectotype designated by Britton & Brown 1913).

**Description:**—Annuals, shrubs, or rarely small trees, covered with bladder hairs. Leaves petiolate, usually lobed or dentate (sometimes entire), very rarely semi-terete. Inflorescences paniculate, composed of small cymose clusters. Flowers sessile and pedicellate, hermaphrodite or some of them female. Perianth segments 5 (rarely 4), free or united at base, green, not changing at fruit. Stamens mostly 5, free or basally connate. Stigmas 2, free. Fruit depressed-globular, falling off separately or together with perianth. Pericarp mostly thin, hyaline, of 1–2(3) parenchymatous layers, usually with small cylindrical or conical papillae (in dry fruits the pericarp structure mostly looks reticulate, and after soaking the papillae retrieve their outline). In some species now transferred to *Chenopodium* (outside of Nepal), the pericarp (at least in the majority of flowers) appears fleshy (berry), coloured, and many-layered, but some of the fruits remain dry (heterocarpy). Seeds black or rarely brownish, with horizontal embryo; outer seed-coat layer (testa) of the black seeds with vertical stalactites.

**Notes:**—About 100 species in recent circumscription, distributed in all parts of the world; some are widespread or cosmopolitan.

## Key to the species

1. Plant robust, up to 2.5 m tall; inflorescence whitish due to presence of bladder hairs on the branches and flower perianth; young leaves often reddish; mature leaves up to 25(−30) cm long ..... 5. *C. bengalensis*
- Plant 15–60(−100) cm; leaves smaller, and, like the inflorescence, green ..... 2
2. All or at least middle and upper leaves lobate with the terminal lobe ca. twice as long as the lateral ones ..... 3
- Leaves without lobes, or the apical lobe slightly or not larger than lateral ones ..... 4
3. Light green plant growing at elevations up to 2200 m; leaves cuneate at base; all or almost all leaves lobate, middle-lobe with ± parallel margins; pericarp when dry with reticulate ultrasculpture, long-papillate in fresh fruits or after soaking; seeds with indistinct keel..... 1. *C. ficifolium*
- Plant dark green, at elevations 2000–3800 m; leaves truncate or slightly cuneate; lower leaves triangular, without lobes, middle and upper leaves lobate, middle-lobe gradually tapering; pericarp almost smooth when dry, with minute papillae in fresh fruits or after soaking; seeds with distinct keel ..... 6. *C. perttii*
4. Leaves mostly entire, rhombic or slightly trilobate with indistinct lateral lobes..... 4. *C. karoi*
- At least lower leaves dentate, rarely entire, but in latter case triangular or lanceolate ..... 5
5. Leaves rhombic to lanceolate, long-petiolate, not fleshy, dorsally green or greyish..... 2. *C. album*
- Leaves fleshy, oblong, short-petiolate (petioles to 1 cm), dorsally gray ..... 3. *C. pallidum*

### 1. *Chenopodium ficifolium* Smith (1800: 276).

Type:—In fimetis et ruderatis [growing on wasteland and dungheaps] about London, *W. Curtis* (K?).

**Description:**—Annual, to 80 cm, loosely branched, ± mealy. Leaves 2–7 × 1–3 cm, 3-lobed, lateral lobes in lower part of leaf short, entire or sinuate; apical lobe long, narrow, with ± parallel margins, irregularly sinuate-dentate. Flowers in small glomerules in ± terminal panicles. Perianth green, later becoming yellow-brown or black-brown, enclosing fruit; segments dorsally slightly carinate. Pericarp separating from the seed. Seeds small, rounded or slightly keeled; testa with narrow elongate pits, without radial furrows.

**Chromosome number:**—2n=18 (Rahiminejad 2006).

**Distribution:**—One of the most widespread species in the tropical and subtropical parts of Eurasia, sporadically in the temperate regions. Common in the tropical part of Nepal (so-called Terai region) and foothills.

**Habitat:**—Disturbed areas, river-sides; 0–2200 m.

**Phenology:**—Flowering March–May; fruiting April–June.

**Specimens examined** (Fig. 1):—WEST NEPAL. **Rapti zone**: [Salyan distr.] Lawamjula, 3000 ft, 28 March 1952,

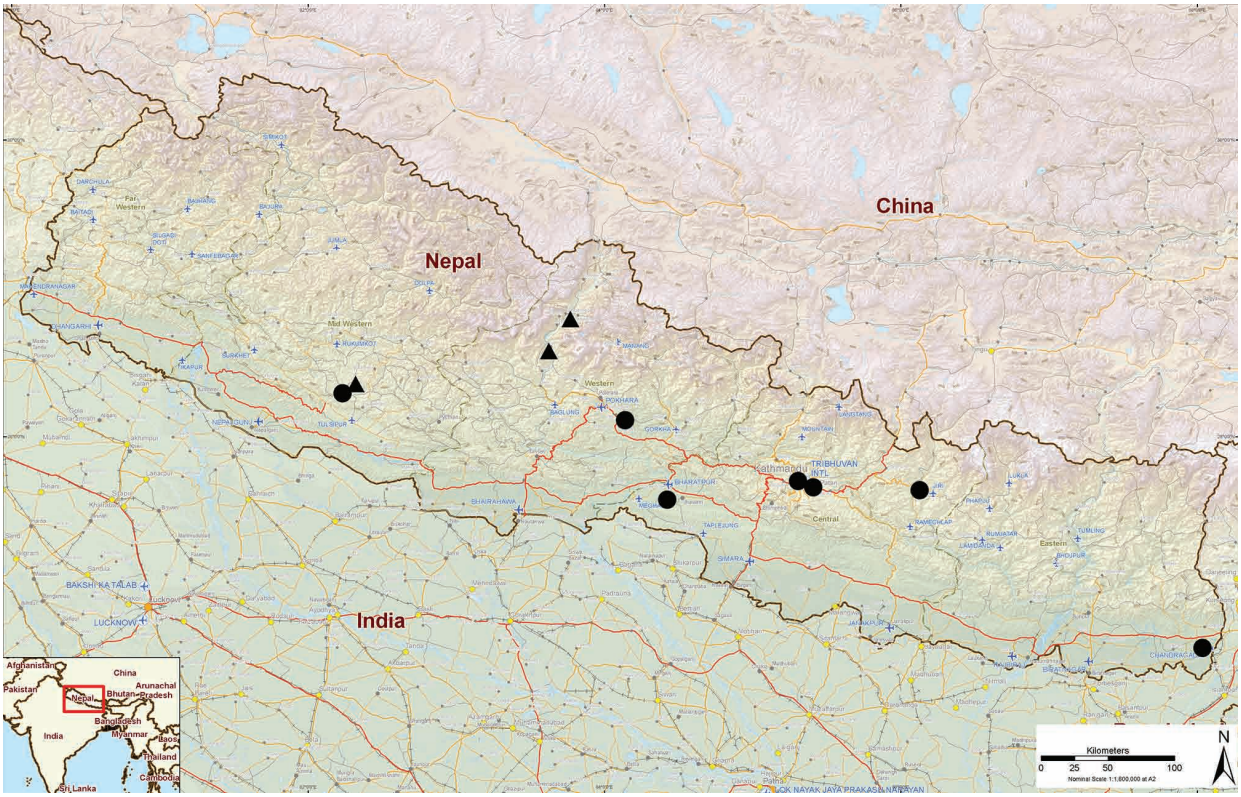


**FIGURE 1.** The distribution of *Chenopodium ficifolium* (dots) and *C. pallidum* (triangles).

*Polunin, Sykes & Williams 686* (BM, LE). CENTRAL NEPAL. **Bagmati zone**: Kathmandu, 5000-7000 ft, 4−8 February 1857, *anonym 13090* (BM); Kathmandu, 27°44'N, 85°19'E, 4500 ft, 17 May 1969, *Williams 38* (BM); Kathmandu distr., Kathmandu, N bank of Bagmati river, Thapathali, 27°41'N, 85°19'E, 1300 m, 20 April 1992, *Long* & *McDermott 21909* (E); [Bhaktapur distr.] Nagarkot to Bhaktapur, 1700 m, 19 March 2012, *Sukhorukov s.n.* (MW). **Gandaki zone**: [Kaski distr.], Burungdi Khola, 5000 ft, 20 May 1954, *Stainton, Sykes & Williams 5344* (BM). **Narayani zone**: Chitwan [distr.], 4 March 2008, *Sukhorukov s.n.* (MW). EAST NEPAL. **Mechi zone**: [Jhapa distr.] Bhadrapur, 1987, anonym (KATH). **Janakpur zone**: [Dolakha distr.] Namdu, April 1995, *Bhandari s.n.* (KATH).

**2. *Chenopodium album*** Linnaeus (1753: 219).

Type (lectotype designated by Brenan 1954):—Herb. Linn. 313.8 (LINN!, image of the lectotype available at http://linnean-online.org/3082/).

**Description:**—Annual, up to 100 cm, erect, branched, green. Leaves to 10 × 4 cm, rhombic, oblong or lanceolate, entire or denticulate, lower leaves often 3-lobed (terminal lobe tapering to apex). Flowers in glomerules arranged in loose inflorescence. Perianth segments keeled. Pericarp papillate (papillae to 80 μm), scraped off the seed; seeds 1.3–1.5 mm, obtuse or acutish on margins, nearly smooth with shallow radial furrows.

**Chromosome number:**—2n=18 (Bhargava *et al.* 2007); 2n=36 (Runemark 1996); 2n=54 (Rahiminejad 2006, Bhargava *et al.* 2007).

**Distribution:**—The most common chenopodiaceous species in Nepal and elsewhere.

**Habitat:**—Disturbed areas; 0–3500 m.

**Phenology:**—Flowering March–September; fruiting April–November.

**Taxonomic notes:**—*C. album* shows a high morphological variability, and several names (at subspecies, variety and form ranks) were published in the past (see e.g., Aellen 1960–61). Furthermore, other taxa [e.g., *C. strictum* Roth (1821: 180), and *C. suecicum* Murr (1902: 341)] are related to *C. album* and the aggregate still needs further investigations in our territory and other parts of Eurasia. On the basis of material examined, plants from Nepal can be identified neither as *C. strictum* which has reddish stem and entire leaves with parallel margins (see e.g. Iamonico 2010) nor as *C. suecicum* distinguished by the rhombic dentate leaves and clearly rugose-reticulate seed ultrasculpture. On the other hand, the Nepali plants are diverse. The populations from Terai region mostly have lateral inflorescence branches appressed to the main stem and acutish seeds with striate ultrasculpture, whereas the montainous plants are distinguished by (almost) horizontally spreading lateral inflorescences and seeds with obtuse margin and pitted ultrasculpture.

**Specimens examined:**—WEST NEPAL. **Karnali zone**: [Dolpa distr.] near Tarakot, Bheri river, 10500 ft, 11 July 1952, *Polunin*, *Sykes* & *Williams 2432* (BM, E); [Dolpa distr.], Dunai, 28°55'N, 82°55'E, 2100 m, 26 April 1974, *Dobremez 2761* (BM, E-00214373); Dolpa distr., Polam, 29°10'N, 82°50'E, 3250 m, 6 October 1991, *Minaki et al. 9104404* (BM); [Jumla distr.], Jumla vill., 23 September 2010, *Sukhorukov 463* (MW). **Seti zone**: Bajhang distr., 19 July 1991, *Suzuki et al. 9160766* (BM); Bajhang distr., Khaptad National Park, trail from Ghoda daune to Lokhada, 29°24'N, 81°8'E, 2559 m, 3 July 2009, *Ikeda et al. 20913048* (E-00509893). CENTRAL NEPAL. **Bagmati zone**: [Rasuwa distr.] Langtang village area, 11500 ft, 1 August 1949, *Polunin 1552* (BM); Langtang, 11500 ft, 22 August 1949, *Polunin 490* (BM); [Bhaktapur distr.], Nagarkot to Bhaktapur, March 2012, *Sukhorukov s.n.* (MW). **Rapti zone**: [Rolpa distr.] Phalabang, 4500 ft, 27 March 1952, *Polunin, Sykes & Williams 654* (E). **Dhaulagiri zone**: [Baglung distr.] near Bongakhani, 500 ft, 5 May 1954, *Stainton*, *Sykes* & *Williams 2708* (BM); Mustang distr., 3185 m, 22 September 1995, *Mikage et al. 9550337*, *9550357* (BM). **Lumbini zone**: Nawalparasi [distr.], Beldiha, 150 m, November 1970, *Makino 10* (BM). **Narayani zone**: Chitwan distr., Sauraha, 160 m, 19 January 1996, *Mikage et al. 9614220* (E-00152131); Chitwan National Park, Sauraha, 4 March 2008, *Sukhorukov 56* (MW, E-00665443). EAST NEPAL. **Mechi zone**: [Taplejung distr.] Talung, 2600 m, 3 October 1971, *Jest 71-18* (E-00214371).

**3. *Chenopodium pallidum*** Moquin-Tandon (1840: 30).

Type (lectotype, here designated):—[Probably NE India] Voyage de V. Jacquemont aux Indes Orient. *1377* (P!) (Fig. 2). Type (epitype, here designated):—NEPAL. [Dhaulagiri zone]: Mustang prov. [distr.], Annapurna Conservation area, Trekking route Jomosom–Muktinath, valley of Khali Gandaki river, between Jomosom & Kagbeni villages, riverside, 2700 m, 22 September 2009, *Sukhorukov 566* (MW!) (Fig. 3).


**FIGURE 2.** Lectotype of *Chenopodium pallidum* (P).


**FIGURE 3.** Epitype of *Chenopodium pallidum* (MW).

**Description:**—Annual, to 40 cm, erect, lateral branches ascending if present. Leaves up to 2 × 1 cm, short-petiolate (petioles to 1 cm), blades fleshy, ovate, slightly cuneate, decreasing in size upwards, green above, greyish below, dentate, margins often red. Inflorescence greyish, aphyllous or bracteate. Perianth ca. 2.5 mm in diameter, its segments almost free, with prominent midrib. Fruits 1.3–1.6 mm in diameter, ca. 0.6 mm thick. Pericarp of 1–2 cell layers, 7–10 µm thick, easily separating from the seed, papillae up to 25 µm. Seed 1.3–1.5 mm, blackish or reddish-black, its sculpture striate, with obtuse or acutish margin (immature seed with acute margin), not swollen, with small depression apically.

**Chromosome number:**—Not known.

**Distribution:**—Nepal, northern Himalaya (India, Pakistan).

**Habitat:**—Disturbed areas; 1500–3200 m.

**Phenology:**—Flowering March–September; fruiting April–November.

**Taxonomic notes:**—This species has been forgotten for a long time and is re-instated at species rank in the present article. It can be recognized by the small, oblong, dentate leaves. Such populations are observed only in the Himalaya based on the revised specimens in BM, E and K. Two authentic sheets seen (P!) were collected in the vegetative or early flowering stage, and additionally an epitype is chosen that contains plants in the fruiting stage.

**Specimens examined** (Fig. 1):—CENTRAL NEPAL. **Rapti zone**: [Rolpa distr.] Phalabang, 4500 ft, 24 March 1952, *Polunin, Sykes & Williams 654* (BM, LE). **Dhaulagiri zone**: [Mustang distr.] Jomosom to Kagbeni, 22 September 2009, *Sukhorukov 566* (MW); Myagdi prov.[distr.], near Dana vill., 1500 m, 11 May 2010, *Sukhorukov 510* (MW).

**4. *Chenopodium karoi*** (Murr) Aellen (Aellen 1929a: 149).

Bas.: *Chenopodium album* subsp. *karoi* Murr (1923: 97).

Type:—[RUSSIA]. Nerczynsk [Nerchinsk], Wüste Orte, 1892, *Karo 169* (holotype, G-Aellen!).

≡ *Chenopodium prostratum* Bunge in Herder (1889: 594) *nom. illegit.* non Schultes (1820), art. 53.1 of ICN (McNeill *et al.* 2012).

**Description:**—Similar to *C. album* but plants dark green, usually with ascendent or procumbent stems. Leaves ± ovate, somewhat longer than broad, with 3 ± equal lobes. Pericarp reticulate in dry fruits, soaked papillae to 50 µm. Seed 1.1–1.3 mm, with striate ultrasculpture, margin obtuse.

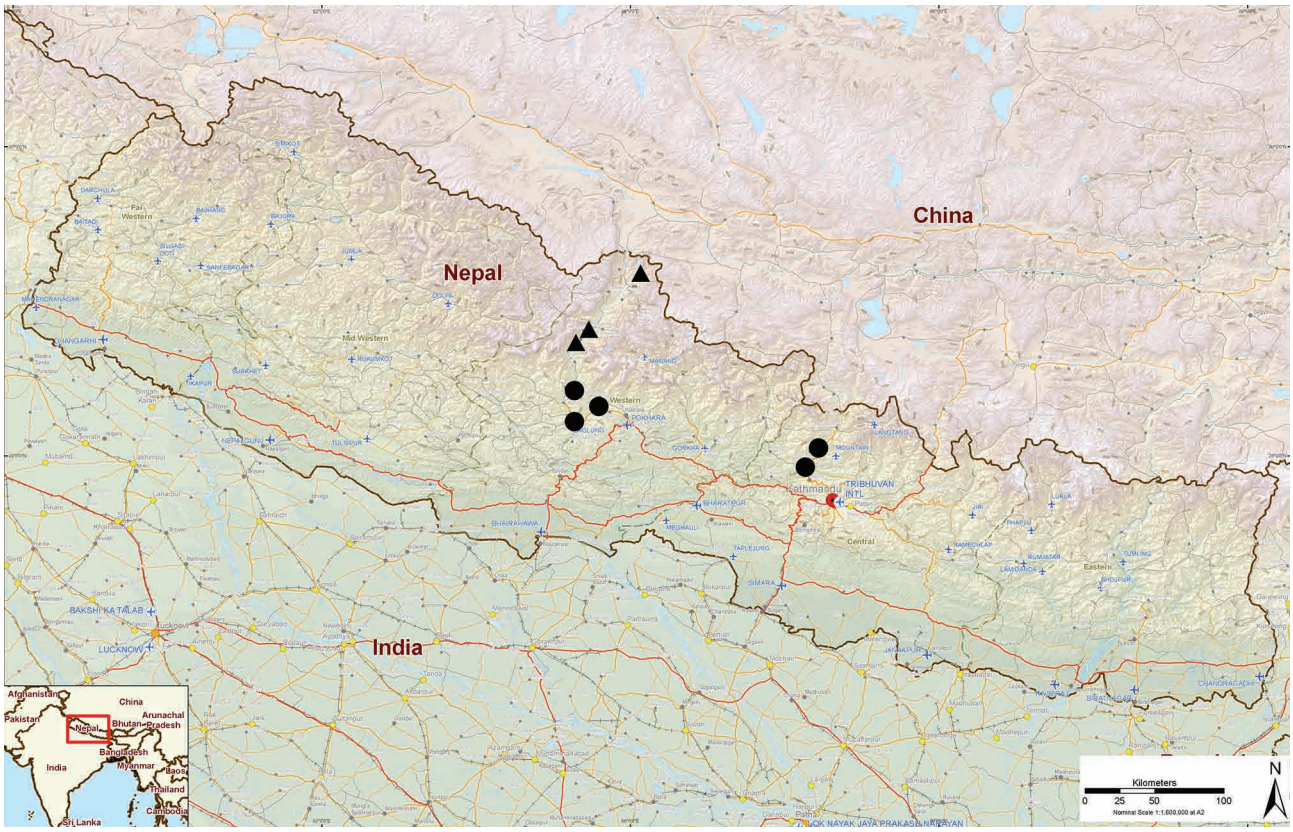


**FIGURE 4.** The distribution of *Chenopodium karoi* (triangles) and *C. bengalense* (dots).

**Chromosome number:**—2n=36 (Zhukova & Petrovsky 1980).

**Distribution:**—Himalaya, Central Asia, Siberia. Recently *C. karoi* was reported from Nepal for the first time (Yonekura 2008).

**Habitat:**—Disturbed areas, rocky habitats; 2500–3800 m.

**Phenology:**—Flowering May–August, fruiting July–September.

**Specimens examined** (Fig. 4):—CENTRAL NEPAL. **Dhaulagiri zone**: [Mustang distr.] Kali Gandaki, ESE of Thini, 12500 ft, 19 July 1977, *Miehe 227* & *228* (BM); Mustang [distr.], Lo Tsho Dhyun, Yara area, 16 July 1998, *Sykes 331/98* (E-00649126); Mustang prov.[distr.], Marpha vill., 17 April 2009, *Sukhorukov s.n.* (E, MW).
Locus ignotus: "Tangler" (KATH).

**5. *Chenopodium bengalense*** (Lamarck) Spielm. ex Steud. (Steudel 1821: 92).

Bas.: *Atriplex bengalensis* Lamarck (1783: 276).

Type (lectotype, here designated):—Plante potagére des Indes [vegetable plant from India], herb. de Lamarck (P-LA-00381128!) (Fig. 5).

Type (epitype, here designated):—NEPAL. [Dhaulagiri zone, Myagdi distr.]: Annapurna conservation area, near Tikhedhunga vill., 1700 m, edge of vegetable garden, 13 November 2008, *Sukhorukov s.n.* (MW!, isoepitype W2010-0007930!).

= *Chenopodium giganteum* D. Don (Don *et al.* 1825: 75).

Type (lectotype, here designated):—*Herb. Wallich 6952 F* [N. Wallich] (K).

= *Chenopodium album* L. subsp. *amaranticolor* Coste & Reynier in Reynier (1905: 979).

Type:—not desginated.

≡ *Chenopodium amaranticolor* (Coste & Reyn.) Coste & Reynier (Reynier 1907: 181).

**Description:**—Robust annual up to 2.5 m, branched from the base. Petioles of lower caducous leaves up to 10 cm, blades 10–25(−30) × 5–10 cm, usually rhombic, dentate, erose or trilobate with elongated terminal lobe; middle leaves rhombic or ovate, smaller, upper ones oblong or lanceolate, completely entire; young leaves often reddish. Inflorescence whitish due to the presence of multiple bladder hairs on the branches and perianth. Perianth segments free at base, keeled along the midvein. Pericarp hyaline, adjoining the seed coat, but separating from it when rubbed, long-papillate in fresh plant or even dry fruits. Seed black, 1.2–1.5 mm, swollen (0.65–0.8 mm thick), smooth, more or less keeled.

**Chromosome number** (sub *Chenopodium giganteum*):—2n=54 (Rahiminejad 2006); 2n=54* (Lomonosova *et al.* 2012).

**Distribution:**—Himalaya and Tibet, and as casual alien in some parts of Eurasia and North Africa (Uotila 1997, 2001a).

**Habitat:**—Edges of vegetable gardens and other places with secondary vegetation; 700–2200 m. Cultivated as crop, but very locally.

**Phenology:**—Flowering June–September; fruiting August–November.

**Taxonomic notes:**—*Chenopodium bengalense* seems to be an older name for the plants occurring in the Himalaya. It was known as *C. giganteum* or *C. album* subsp. *amaranticolor* in the Himalayan accounts if recorded (Hara 1971, Long 1984). The precise nomenclature of red-leaved *Chenopodium* taxa is still not well-established, but the oldest names of the relatives—*C. purpurascens* Juss. ex Jacquin (1776: 43) or *C. atriplicis* Linnaeus filius (1782: 171)—are not applicable to the plants known from Nepal and India (Aellen 1929b, Uotila 2001a). Although Don *et al.* (1825) reported that the lower (caducous) leaves are dentate only, they are usually trilobate with a more or less elongated terminal lobe. This is also true for *C. bengalense* grown from the seeds that were received from Bengalia from Mr. Renaud St. Germain [Joseph Pierre Xavier Renault de Saint-Germain, 1733–1819, governor of Chandanagore, French India, now Chandannagar, West Bengal, for further details see Bryant (2013)]. Both authentic specimens of *Atriplex bengalensis* kept at P-LA were probably collected from one plant cultivated in the Royal Botanic Garden in Paris (Lamarck 1783). One of them (selected here as lectotype) is the most representative specimen gathered in the flowering stage, with the addition of two trilobate vegetative leaves (probably from the main branch), and the second specimen (P-LA-00381127) contains a vegetative branch only. Both specimens were apparently seen by J.R. Spielmann who transferred *A. bengalensis* into *Chenopodium* (Spielmann in Steudel 1821). It is unclear why the shoots were gathered by Lamarck in the early blooming stage and not later when the differences between *Atriplex* and *Chenopodium* are most striking. In addition to the lectotype, an epitype and isoepitype specimens with seeds are here designated (all branches of the epitype and isoepitype are part of one individual, so the art. 9.15 can be applied).


**FIGURE 5.** Lectotype of *Atriplex bengalensis* (P-LA).


**FIGURE 6.** Holotype of *Chenopodium perttii* (BM).

**Specimens examined** (Fig. 4):—CENTRAL NEPAL. **Dhaulagiri zone**: [Baglung distr.] near Lumsum, 8000 ft, 10 September 1954, *Stainton, Sykes & Williams 4315* (BM; LE); [Myagdi distr.] between Ramche and Gram, 1800–1900 m, 20 August 1972, *Kanai et al. 723625* (BM); [Myagdi distr.] Annapurna conservation area, near Tikhedhunga vill., 1700 m, 13 November 2008, *Sukhorukov s.n.* (MW*, W2010-0007930). **Bagmati zone**: Nuwakot distr., Bidur, *anonym s.n.* (KATH); [Rasuwa distr.] Dunche [Dhunche], 2000 m, 22 August 1972, *Kanai et al. 723624* (BM).

**6. *Chenopodium perttii*** Sukhor., *sp. nov*.

Type:—NEPAL. [Dhaulagiri zone]: Mustang [distr.], 13000 ft, at edge of field, 3 August 1954, *Stainton, Sykes & Williams 2159* (holotype BM-000832654! iso LE!) (Fig. 6).

**Description:**—Annual up to 100 cm with erect, scarcely branched stem. Leaves dark green, petiolate (petioles up to 3 cm), blades 3–4 × 2–3 cm, base truncate or broadly cuneate, margins often red; lower leaves triangular, entire or dentate, middle leaves trilobate with elongated mid-lobe (ca. twice as long as the lateral ones) gradually tapering to apex and slightly upward-directed lateral lobes, lobes mostly entire; upper leaves also trilobate or entire, narrowly oblong. Inflorescence green, aphyllous or rather bracteose. Perianth segments keeled. Pericarp separating from the seed (not easily), with minute papillae that are hardly restored after soaking before SEM (Fig. 7), almost smooth in dry fruits. Seed ca. 1.5 mm, prominently keeled (Fig. 8).

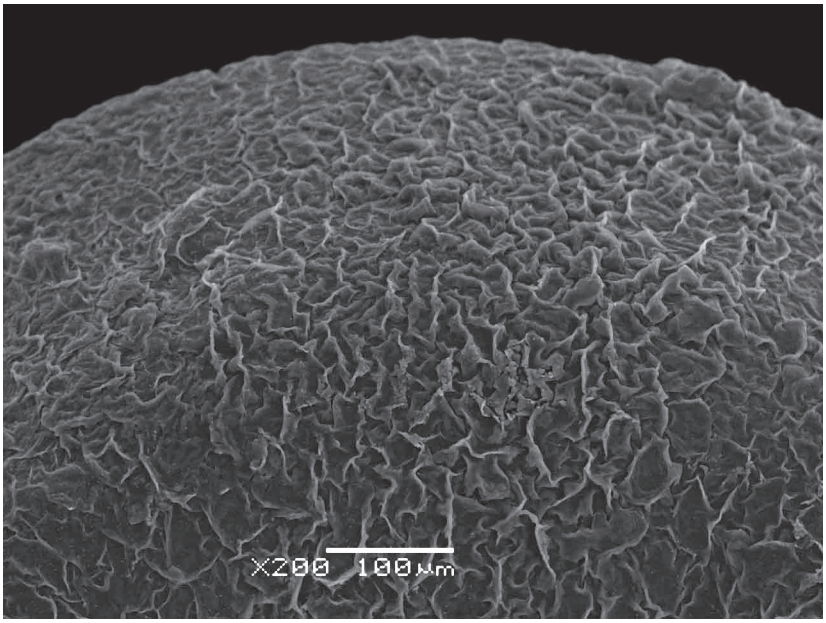


**FIGURE 7.** Pericarp surface of *Chenopodium perttii* with small papillae (most of them poorly restored). Scale bar—100 µm [voucher: Nepal, Muistang, 3 August 1954, *Stainton, Sykes & Williams 2159* (BM)].

**Etymology:**—The new species is dedicated to Dr. Pertti Uotila, Professor at the Botanical Museum of the University of Helsinki (Finland), connoisseur of the genus *Chenopodium* and its relatives worldwide.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya. Often in Mustang district.

**Habitat:**—Disturbed places, often as weed in the fields with crop; 2400–3800 m.

**Phenology:**—Flowering July–September; fruiting August–October.

**Conservation status:**—The appropriate data on abundance and/or distribution of the taxon is lacking. It can be included in the Data Deficient (DD) as well as Not Evaluated (NE) of IUCN Red List categories (IUCN 2010) as there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

**Taxonomic notes:**—Morphologically *Chenopodium perttii* is related to *C. bryoniifolium* Bunge (1876: 10) growing on gravelly substrates or in wet mossy sites in Siberia and the Far East. However, all or almost all leaves of *C. bryoniifolium* are trilobate, and the seeds lack a sharp keel. The specimens of *C. perttii* look similar to *Chenopodium album* subsp. *yunnanense* Aellen in Handel-Mazzetti (1929: 161) described from Yunnan province [Type (lectotype,

here designated):—CHINA. Yunnan: Yunnanfou, ruderale in agris et viarum marginibus planitiei, 1900 m, 20 May 1916, *Schoch 107* WU-0059359!, isolectotype K!]. In contrast to *C. perttii*, the ripe seeds of *C. album* subsp. *yunnanense* are not keeled. Both of these taxa are peculiar in that the papillae on the pericarp surface are minute (not long as in other taxa of the Eurasian *Chenopodium album* group). They are hardly restored after soaking before SEM examination, and the pericarp surface appears smooth (not reticulate) in the dried fruits.

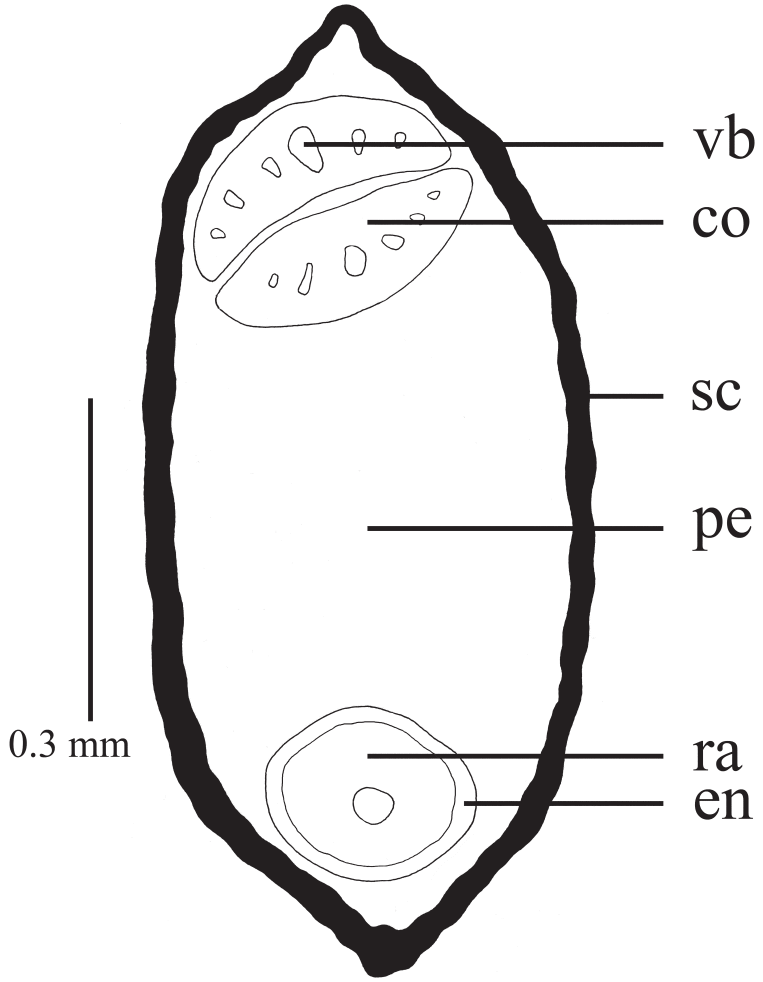


**FIGURE 8.** Schematic seed outline and structure of *Chenopodium perttii*. Abbreviations: co—cotyledon, en—endosperm (small stripe around the radicula), pe—perisperm, sc—seed coat, vb—vascular bundles in the cotyledons. Scale bar—0.3 mm.

**Specimens examined** (Fig. 9):—WEST NEPAL. **Karnali zone**: [Jumla distr.] Jumla vill., 2400 m, 27 September 2010, *Sukhorukov 567* (MW). CENTRAL NEPAL. **Dhaulagiri zone**: [Mustang distr.] Thinigaon, Muktinath Himal, 11500 ft, at edge of field, *Stainton, Sykes & Williams 1372* (LE). **Gandaki zone**: Manangbhot distr., Tilicho base camp (4000 m ) to Khangsar (3650 m), 1 August 1983, *Ohba et al. 8331076* (E-00238402).

**Additional specimens seen** (Fig. 15):—INDIA. Himachal Pradesh: Lahul, Udaipur, Chimrat, 2900 m, 2 August 1990, *McBeath 2275* (E). CHINA. [Tibet] Nyalam county: Zhangmu, 13 May 1966, *Zhang & Lang 3361* (PE-00510187); [Tibet] Gerze county, August 1972, *Li 67* (PE-00510178); Zhag'yab county, 7 August 1976, *anonym 9492* (PE-00235126).

**2. *Chenopodiastrum* Fuentes-Bazan *et al.* (2012b: 14)**

Type:—*Chenopodiastrum murale* (Fuentes-Bazan *et al.* 2012b: 14).

**Description:**—Annuals, glabrous or covered with bladder hairs, sometimes with scattered yellowish glands. Leaves triangular or rhombic, petiolate, entire, dentate or lobate, rarely pinnatisect. Inflorescences spreading, mostly leafless.

Flowers bisexual, with 5 free or basally connate segments not changing at fruit. Stamens 5. Stigmas 2. Fruits 1.3–2.5 mm in diameter; pericarp 1–2-layered, with conical or cylindrical papillae (forming alveolate or reticulate surface when dry). Seed black, with keel or not, alveolate or punctate, sometimes with deep combs. Seed-coat testa with vertical or obliquely oriented stalactites; latent structural heterospermy expressed in varying testa thickness is observed in some species. Seed embryo horizontal.

**Notes:**—At least 7 species in Eurasia, Africa and North America.

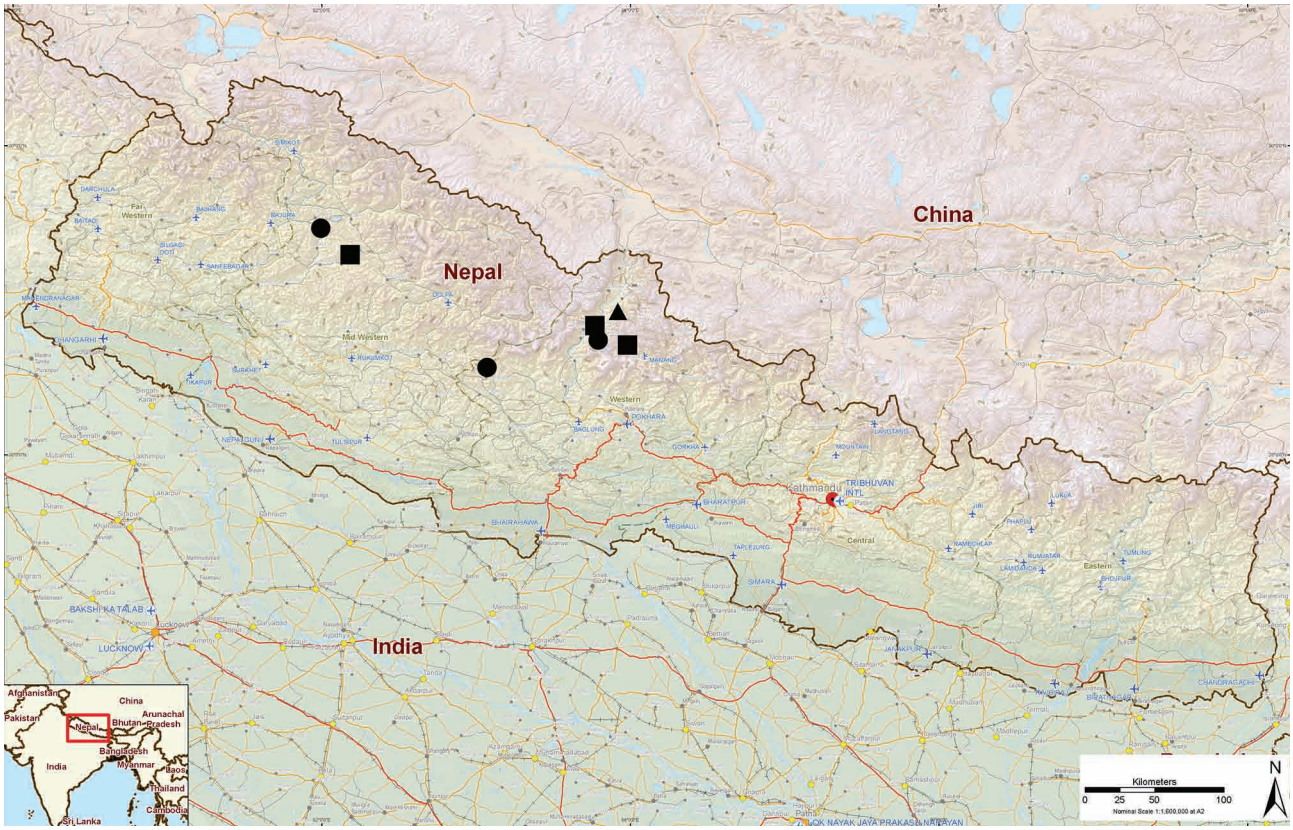


**FIGURE 9.** The distribution of *Chenopodium perttii* (squares), *Chenopodiastrum badachschanicum* (dots) and *Oxybasis glauca* (triangle).

## Key to the species

1. Leaf blade cuneate, dentate. Seed 1.3–1.4 mm in diameter, with prominent keel.…… ..... 1. *C. murale*
- Leaf blade truncate or slightly cordate, entire or with a few lobelike teeth. Seed 1.4–2 mm in diameter, without keel. ..... …… ..... ..... 2. *C. badachschanicum*

### 1. *Chenopodiastrum murale* (Linnaeus) Fuentes-Bazan *et al.* (2012b: 14).

*Chenopodium murale* Linnaeus (1753: 219).

Type (lectotype, designated by Brenan 1954):—Herb. Linn. 313.6 (LINN!, image of the lectotype available at http://linnean-online.org/3080/).

**Description:**—Annual, 10–70 cm, erect, much-branched, dark green, slightly mealy. Leaves 2–6 × 1–5 cm, broadly deltoid-ovate, upper leaves narrow and long-acuminate, mucronulate, cuneate to rounded at base, coarsely and irregularly dentate, rarely subentire; teeth acute and ± incurved. Inflorescences terminal and axillary, of loosely branched cymes; glomerules small. Perianth segments slightly keeled, with a distinct swelling below apex. Pericarp tightly adjoining the seed. Seeds 1.3–1.4 mm, with prominent keel, their surface densely covered with small pits.

**Chromosome number** (sub *Chenopodium murale*):—2n=18 (Bhargava *et al.* 2007, Lomonosova *et al.* 2012).

**Distribution:**—Widely distributed in tropics and subtropics in all parts of the world. Origin unknown but Sukhorukov (2014) proposed that it can be connected with Eastern Africa and the Mediterranean area. Apparently

this species is seldom collected in Nepal, although it is not rare, e.g. in some parts of Central Nepal at elevations 0–1500 m.

**Habitat:**—Disturbed places.

**Phenology:**—Flowering March–September, fruiting May–October.

**Specimens examined:**—CENTRAL NEPAL. **Rapti zone**: [Rolpa distr.] Phalabang, 4500 ft, 24 March 1952, *Polunin, Sykes & Williams 654* (BM); observed by Sukhorukov in Kathmandu valley and near Bidur village (Bagmati zone).

**2. *Chenopodiastrum badachschanicum*** (Tzvelev) Fuentes-Bazan & al. (2012b: 14)

Bas.: *Chenopodium badachschanicum* Tzvelev (1960: 434).

Type:—TAJIKISTAN. Gorno-Badakhshan Autonomous province: Pamir occid., in declivitate lapidosa paulo ruderata in valle fl. Murgab 3–4 km infra ostium fl. Pschart occidentalis, 3300 m, 19 June 1958, *Tzvelev 220* (holotype LE, recently on loan in H, n.v.).

**Description:**—Annual, to 100 cm, almost glabrous or only slightly mealy in the upper part. Leaves long-petiolate, petioles up to 10 cm, blades triangular, up to 15 cm long, entire or with 1–2 small lateral lobes. Inflorescence aphyllous, very lax. Perianth segments free, slightly keeled or smooth. Pericarp brownish, easily ruptured, almost not reticulate in dry fruits. Seeds depressed-globular, 1.4–2 mm, 0.9–1.1 mm thick, with no keel, shining, slightly alveolate or smooth.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya, Central Asia, southern Siberia. Rare in Nepal.

**Habitat:**—Rocks and screes; 3000–4000 m.

**Phenology:**—Flowering July–September; fruiting August–October.

**Taxonomic notes:**—The specimens collected from the type locality in West Pamir (topotype at LE!) are not identical to the specimens growing in the Himalaya. These typical plants are much smaller (up to 30 cm tall), leaves also smaller, narrowly triangular, with 1–3 prominent acute lobes, the upper leaves with elongated terminal lobes, pericarp tightly adjoining the seed. The related taxa growing in Himalaya, Altai and Tibet need further investigation.

**Specimens examined** (Fig. 9):—WEST NEPAL. **Karnali zone**: [Mugu distr.] Purana Mugu, Mugu Khola, 13000 ft, 23 August 1952, *Polunin, Sykes & Williams 3010* (LE). CENTRAL NEPAL. **Rapti zone**: [Rukum distr., near Ranmamaikot] Seng Khola, 13000 ft, 2 October 1954, *Stainton, Sykes & Williams 4674* (LE); reported for the Mustang province (Yonekura 2008).

**3. *Oxybasis* Karelin & Kirilov (1841: 738).**

Type:—*Oxybasis minutiflora* Karelin & Kirilov (1841: 739) [= *O. chenopodioides* (Linnaeus) Fuentes-Bazan *et al.* (2012b: 15)].

**Description:**—Annuals, branched from the base or with single stem, glabrous or covered with bladder hairs. Leaves alternate, entire to lobate, rhombic, triangular or oblong. Inflorescence racemiform, with lateral branches mostly appressed to the stem; flowers arranged in dense glomerules. Perianth of 2–5 free or diversely connate, hyaline or greenish segments (in some species both perianth forms are present). Flowers bisexual or (lateral ones) sometimes female. Stamens 1–5. Stylodia 2. Pericarp thin, smooth, mamillate or rarely papillate. Seeds usually small (up to 1.2 mm in diameter), red or black. Embryo horizontal or vertical, and not infrequently both embryo positions may be present in one individual (spatial heterospermy). Structural (latent) heterospermy expressed in the varying thickness of seed coat is common in almost all representatives; outer cell wall of the testa with stalactites.

**Notes:**—About 12 species in the temperate parts of Eurasia and America.

**1. *Oxybasis glauca*** (Linnaeus) Fuentes-Bazan *et al*. (2012: 15).

Bas.: *Chenopodium glaucum* Linnaeus (1753: 220).

Type (lectotype, designated by Uotila 1993):—Herb. Linn. 313.17 (LINN!, image of the lectotype available at http://linnean-online.org/3142/).

**Description:**—Annual, to 70 cm (much smaller at high elevations), branched from the base; stem often prostrate or

ascending, rarely straight. Leaves to 6 × 2 cm, petiolate, cuneate at base, oblong or lanceolate, dentate or lobate with 2–5 lobes, rarely entire, green adaxially, grey or whitish below. Inflorescence leafy, loose. Perianth segments 3 to 5, almost free, with hyaline margins, keeled along midrib, opened at fruiting stage. Fruits 0.65–0.8 mm in diameter, pericarp smooth, whitish, often ruptured. Seeds reddish, without keel; embryo in both vertical and horizontal positions (spatial heterospermy).

**Chromosome number** (sub *Chenopodium glaucum*):—2n=18 (Lomonosova *et al.* 2003, Rahiminejad 2006); 2n=36 (Lomonosova 2006).

**Distribution:**—Eurasia (mostly temperate regions). In Nepal it is rare and encountered only at high elevations (2800–4000 m).

**Habitat:**—Near streams or other wet places.

**Phenology:**—Flowering July–September, fruiting August–October.

**Specimens examined** (Fig. 9):—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang distr., Chuksang (2970 m)–Tetang (3000 m)–Gnyu Pass (4100 m), 28°55'N, 83°49'E–28°51'N, 83°51'E, 13 July 2000, *Iokawa et al. 20020169* (E-00435483). Also collected in China near the border with Nepal: [Tibet, Xigatse] Tingri, July 1921, *Wollaston 265* & *266* (K!).

## 4. *Atriplex* Linnaeus (1753: 979)

Type:—*Atriplex hortensis* Linnaeus (lectotype designated by McNeill *et al.* 1983).

**Description:**—Annual herbs or subshrubs/shrubs, covered in bladder hairs with short basal cell; occasionally other hair types (simple bristle-like or curved hairs) can be found under higher magnification. Leaves alternate or opposite, simple, flat, petiolate. Inflorescence leafy or not, consisting of few or many flowers which are usually unisexual. The male and bisexual flowers are enclosed by (3–)5 green perianth segments, in bisexual flowers unchanged in fruit; the female ones are supported by 2 perianth segments (often called bracteoles or bract-like cover), which are free or connate to varying degrees. Seeds have a vertical embryo, rarely some seeds are with horizontally oriented embryos. Often (mostly in annual species) heterospermy is present (seed coat black and brownish/reddish).

**Notes:**—The richest genus among the Chenopodiaceae (ca. 260 species).

### 1. *Atriplex hortensis* Linnaeus (1753: 1053).

Type (lectotype, designated by McNeill *et al.* 1983):—Hort. Sicc. Cliff. 000647538 (BM!, image of the lectotype available at http://www.nhm.ac.uk/resources/research-curation/projects/clifford-herbarium/lgimages/BM000647538.JPG).

**Description:**—Annual, to 150 cm, erect, usually branched. Leaf petioles 1.5–3 cm, blades 4–15(−22) × 3.5–7(−20) cm, triangular-hastate or ovoid, entire or dentate, basally slightly cordate or rounded, apically obtuse, green or reddish, glabrous or with scattered bladder hairs on lower surface. Inflorescence mostly basally leafy, spike-like. Two kinds of flowers are present: the first type consists of male and bisexual flowers surrounded by a perianth with (4)5 segments. The second consists of female flowers supported only by two accrescent, basally connate perianth segments forming a bract-like cover up to 12(–20) mm in diameter. Pericarp hyaline, 1(2)-layered. Seeds heterospermic. The black seeds (1.6–1.8 mm in diameter) are formed in both flower types, while the brownish ones (2–3.5 mm) appear usually in the bisexual flowers.

**Chromosome number:**—2n=18 (Ruas *et al.* 2001).

**Distribution:**—Eurasia (seems to be native only in southern Europe and Turkey), cultivated and sometimes well established in Northern Himalaya, North & South America, Australia.

**Habitat:**—Disturbed areas; 0–2000 m.

**Phenology:**—Flowering July–October, fruiting September–November.

**Specimens examined**:—Nepal ("Napalia"), [year] 1821, *Wight 9089* (LE).

## 5. *Microgynoecium* Hooker (fil.) in Bentham & Hooker (1880: 56)

Type:—*Microgynoecium tibeticum* Hooker (fil.) (holotype).

**Description:**—Glabrous monoecious annuals, to 20 cm, stems branched, prostrate. Leaves petiolate (petiole up to 1.5 cm), green, blades up to 1.5 cm, decreasing in size upwards, entire, ovate or oblong. Male flowers inconspicuous, of 5 hyaline segments and 2–4 stamens; female flowers hidden in bract (each bract usually has 3 female flowers), without a normal perianth. Fruits and seeds dimorphic. In the first type fruits are reddish-brown, 0.9–1 mm long, 0.4–0.5 mm thick, ear-like pericarp appendages in upper part of the fruit up to 0.1 mm and much smaller in the lower part; pericarp 1-layered, some cells papillate. Testa of seeds 10–12 µm thick, undulate, outer cell walls with stalactites. In the second type fruits are dark, 1–1.5 mm, 0.75–0.8 mm thick (visibly swollen), ear-like pericarp outgrowths up to 0.1 mm, expressed throughout; pericarp 1-layered, with papillate cells, 12–15 µm. Seed testa 20–25 µm thick. Tegmen of both seed types minute; embryo vertical, annular; perisperm present. The fruit anatomy is similar to that of *Archiatriplex* Chu (1987: 461) especially in the emergence of the pericarp appendages over the whole fruit surface (Sukhorukov 2014).

**Notes:**—One species in Himalaya, Tibet, Pamir and Tian-Shan.

**1. *Microgynoecium tibeticum*** Hooker fil. (1890: 9).

Type (lectotype, here designated):—[INDIA]. [Uttarakhand state, Kumaon division] Topedunga, 15000 ft, *Strachey & Winterbottom 1* (K!, image of the lectotype available at http://apps.kew.org/herbcat/getImage.do?imageBarcode=K000898740, isolectotype K!).

**Description:**—See the genus description.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya. Rare in Nepal.

**Habitat:**—Screes, grassy slopes or as ruderal; 3500–5500 m. In the Himalaya and Tibet this plant reaches the highest elevations for flowering plants.

**Phenology:**—Flowering August–October; fruiting September–November.

**Taxonomic notes:**—*Microgynoecium tibeticum* was described from two places located to the west and east of Nepal, Indian Kumaon and Sikkim (Hooker f. 1890). In the mid 20th century it was found in Central Asia (in Tajikistan northwards to Kazakhstan: LE); however, the Central Asian populations differ in carpological characters (Sukhorukov 2014) and deserve recognition at species rank.

**Specimens examined** (Fig. 10):—WEST NEPAL. **Karnali zone**: Below Namja La, grazed slopes, 15500 ft, 22

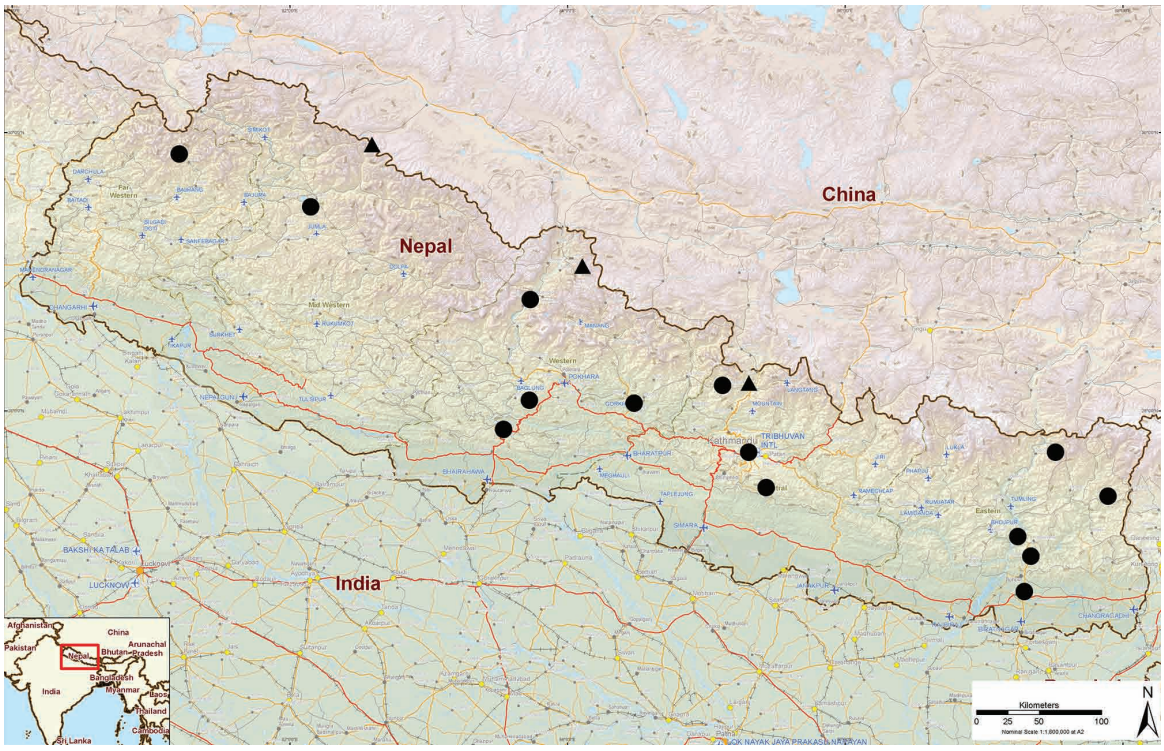


**FIGURE 10.** The distribution of *Microgynoecium tibeticum* (triangles) and *Dysphania ambrosioides* (dots).

August 1952, Polunin, Sykes, Williams *5387* (BM). CENTRAL NEPAL. **Bagmati zone**: [Rasuwa distr.] Langsisa Kharka, 15000 ft, 15 June 1949, *Polunin 348* (BM). **Dhaulagiri zone**: Mustang distr., Lo-Manthang (3809 m), NW of Lo-Manthang (4300-4500 m), 4500 m, 29°15'N, 83°55'E, 21 August 2002, *Miyamoto et al. 20220226* (E-00238922).

### Tribe Anserineae Dumortier (1827: 20)

### 6. *Blitum* Linnaeus (1753: 4)

Type (lectotype, designated by Britton & Brown 1913):—*Blitum capitatum* Linnaeus (1753: 4).

**Description:**—Annual or perennial herbs, glabrous or covered with bladder hairs (scattered glandular hairs may be present). Leaves long-petiolate with triangular, hastate or trullate blades; basal leaves often with short internodes forming a leaf rosette. Inflorescences as a rule leafy or in upper part aphyllous. Flowers in dense glomerules, bisexual or sometimes unisexual. Perianth of 1–5 free or insignificantly concrescent segments, or perianth reduced, green, but in the fruiting stage sometimes fleshy and red, or indurated. Stamens 1–5, usually equalling the perianth segments. Stigmas 2–3. Fruits with 1–2(3)-layered, smooth, mamillate or rarely papillate pericarp, free or tightly adjoining the seed coat. Seed round or ovoid, red or reddish-black, without keel or with 2 blunt keels. Seed surface smooth or alveolate, its cells without stalactites, or rarely the testa cells have hair-like outgrowths. Seed embryo horizontal or vertical, or sometimes both embryo positions present in an individual (spatial heterospermy).

**Notes:**—About 12 species worldwide.

**1. *Blitum virgatum*** Linnaeus (1753: 4).

Type (lectotype, designated by Jafri & Rateeb 1978):—Herb. Linn. 14.2 (LINN, image available at http://linnean-online.org/60/).

= *Morocarpus foliosus* Moench (1794: 342).

Type: not designated.

≡ *Chenopodium foliosum* (Moench) Ascherson (1864: 572).

**Description:**—Annual or short-lived perennial up to 60 cm tall, glabrous or in the upper part covered with scattered glandular hairs. Basal leaves numerous, to 25 cm, cauline leaves to 20 cm, long-petiolate, with triangular blades, truncate or slightly cuneate at base, margins dentate. Inflorescence leafy to the apex. Flowers in dense clusters up to 8 mm in diameter. Perianth segments 3–5, united basally, green and membranous at anthesis but usually turning red and fleshy at the fruiting stage. Pericarp adhering to the seed coat, hyaline, consisting of 1(2) very thin layers. Seeds ovoid, 1–1.2 × 0.7 mm, dark red, with groove and two blunt keels.

**Chromosome number** (sub *Chenopodium foliosum*):—2n=18 (Lomonosova *et al.* 2003).

**Distribution:**—Temperate Eurasia, native in the mountains of Europe, Caucasus, South Siberia, Central Asia and Himalaya. Rare in Nepal.

**Habitat:**—Rocky slopes; sometimes cultivated and used as "berries"; 2600–4000 m.

**Phenology:**—Flowering June–August, fruiting July–September.

**Specimens examined**:—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang distr., Muktinath, 12500 ft, 26 June 1954, *Stainton, Sykes & Williams 1431* (BM, LE); [Mustang distr.] Larjung, S. of Tukuche, Kali Gandaki [river], 8500 ft, 10 June 1954, *Stainton, Sykes & Williams 1066* (BM, LE, E); [Mustang distr.] Jomosom, 28°46'N, 83°54'E, 20 May 1974, *Dobremez 3067* (BM, E-00214397); Muktinath, 28°48'N, 83°52'E, 3500 m, 22 July 1983, *Kanai 10631* (BM, E-00156637).

### Tribe Dysphanieae Pax (1889: 92)

### 7. *Dysphania* Brown (1810: 411)

Type:—*Dysphania littoralis* Brown (1810: 412) (holotype).

**Description:**—Aromatic annuals or rarely small subshrubs covered with glandular hairs, glands or simple hairs. Leaves alternate, entire, lobate or pinnatisect. Inflorescence lax or dense, leafy or not, consisting of cymes that are often reduced to one flower only. Perianth segments 2–5, free or variously connate, the midrib usually with keel. Stamens 1–5. Styles 2, free or basally connate. Fruit subglobose or rarely flattened, 0.3–1.5 mm, its surface reticulate or papillous, dark and often with whitish longitudinal stripes. Pericarp adjoining the seed coat, hyaline, consisting of 1–2 very thin layers, separating from the seed. Seed reddish or reddish black, its testa (outer seedcoat layer) in cross-section lacking vertical tannin-like deposits called "stalactites". Embryo horizontal or vertical.

**Notes:**—About 48 species worldwide mostly in the tropics and subtropics; some taxa often being aggressive weeds. All Nepali native species are closely related and belong to *Dysphania* sect. *Botryoides* Mosyakin & Clemants (2002: 383).

**Key to species**

1. Leaves entire, sinuate or inconspicuously lobate. Annuals up to 15 cm. Embryo vertical. ..... 2. *D. himalaica*
- At least lower leaves lobate or pinnatifid. Embryo horizontal, rarely (in *D. ambrosioides*) both embryo positions may be present in the same plant ..... 2
2. Annuals or short-leaved perennials up to 1.5 m tall, growing mostly at elevations up to 2200 m; inflorescence dense, spike-like; perianth connate to half way or nearly so, enclosing the fruit completely and falling with the fruit; fruit mostly in its upper part covered with glandular hairs ..... 1. *D. ambrosioides*
- Annuals, mostly much smaller, growing at higher elevations; inflorescence loose, thyrsoid; perianth almost free, star-like when open and persistent at fruiting; pericarp entirely short-papillate ..... 3
3. Plant up to 80 cm; stem, especially in the upper parts, densely covered with both simple and glandular hairs; perianth with glandular and simple hairs ..... 3. *D. neglecta*
- Plant up to 50 cm; stem covered mostly with glandular hairs; perianth with simple hairs and subsessile glands ..... 4
4. Leaves pinnatisect; plant often with both yellow and orange glands ..... 4. *D. bhutanica*
- Leaves pinnatifid or lobate; plant with yellow glands ..... 5. *D. nepalensis*

**1. *Dysphania ambrosioides*** (Linnaeus) Mosyakin & Clemants (2002: 382).

Bas.: *Chenopodium ambrosioides* Linnaeus (1753: 219).

Type (lectotype, designated by Brenan 1954):—Herb. Linn. 313.13 (LINN!, image of the lectotype available at http://linnean-online.org/3087/).

**Description:**—Annual or short-lived perennial up to 1 m, aromatic, covered (at least in young parts of the plant) with curved simple hairs, yellow (subsessile) glands and glandular hairs with a prominent stalk. Leaf long-petiolate, 5–16 × 1–3 cm, elliptic-oblong or lanceolate, dentate or sinuate; upper leaves often entire. Inflorescence usually much branched, spike-like, mostly with bracts or in upper part aphyllous. Flowers sessile. Perianth segments 5, green, ca. 1 mm, united to half way or nearly so, concave near the apex, enclosing the fruit completely. Pericarp very thin, hyaline, tightly adjoining the seed coat, but separating from it when rubbed, in its upper part with glandular hairs (up to 120 μm), with large terminal cell. Seed dark red or almost black, 0.7 × 0.5–0.6 mm. Embryo horizontal, rarely oblique or vertical.

**Chromosome number** (sub *Chenopodium ambrosioides*):—2n=32 (Grozeva & Stoeva 2006).

**Distribution:**—America (native in South & Central America), Eurasia, Australia. Quite common in many places in Nepal.

**Habitat:**—Disturbed places and river sides, gravelly substrates; 0–2200 m.

**Phenology:**—Flowering June–October, fruiting August–November. Fruits can be seen on the plants growing up to 2200 m. At higher elevations the plants do not produce flowers and fruits.

**Taxonomical notes:**—In the species circumscription, we follow the opinion of Mosyakin & Clemants (2002) and Iamonico (2011), with separation of *D. anthelmintica* (L.) Mosyakin & Clemants.

**Specimens examined** (Fig. 10):—WEST NEPAL. **Seti zone**: Bajhang distr., 19 August 1991, *Suzuki et al. 9160762* (BM). **Karnali zone**: Mugu distr., 1 km S of Rara Lake, 2900 m, 29 September 2013, *Sukhorukov 108* (MW)—Only young plants, not flowering. CENTRAL NEPAL. **Lumbini zone**: [Palpa distr.] Tansing [Tansen], 3000 ft, 5 October 1959, *Stainton, Sykes & Williams 8747* (E, BM, LE). **Bagmati zone**: Phulchoki, 8500 ft, 8 September 1967, *Manadhar 7397* (BM); [Kathmandu distr.] Godawari, September 2005, *Sukhorukov s.n.* (MW). **Gandaki zone**: [Syangja distr.] Andhi Khola, 2500 ft, 1 October 1954, *Stainton, Sykes & Williams 8700* (BM); Gorkha distr., Gorkha, near Gorkhakali temple, 28°00'N, 84°37'E, 1200 m, 22 August 2008, *Ikeda et al. 20812007* (E-00640133). **Dhaulagiri zone**: Myagdi [distr.], Annapurna conservation area, trekking route Jomosom-Ghorepani, Tatopani village, Kali Gandaki river, 1200

m, 11 May 2010, *Sukhorukov 120* (W2010-0015369; E-00428104). EAST NEPAL. **Koshi zone**: [Dhankuta distr.] Dhankuta, 26°58'N, 87°20'E, 980 ft, 6 July 1969, *Williams 1155* (BM); Dhankuta distr., 27°00'N, 87°15'E, 2 July 1988, *Suzuki et al. 8820036* (BM); [Sunsari distr.], Dharan, 26°50'N, 87°20'E, 1500 ft, 3 September 1967, *Williams & Stainton 8341* (BM); Sankhuwasabha distr., slopes near Hatiya, upper Arun valley, 27°44'N, 87°20'E, 1600 m, 13 October 1991, *Long et al. 769* (E); Bhojpur distr., 1610 m, 1 November 1995, *Mikage et al. 9558269* (E-00229908).

**2. *Dysphania himalaica*** Uotila (2013: 68).

Type:—INDIA. Jammu & Kashmir: Ladakh, Region Indus valley, Stot (E), Nyi [Nior Nis; Njurnis] to Neboche, 33°28'13''N, 78°14'25''E, 4600–4700 m, 2 September 2005, code 05-29-16, *Klimes 6175* (holotype PRA-photo!; isotypes H-1758789! PRA).

**Description:**—Annual, to 15 cm, very branched from the base forming "bushy" habit. Leaves appressed to the stem, short-petiolate, to 4 × 1 cm, narrowly oblong or lanceolate, entire, sinuous or slightly lobate, green, with scattered simple hairs and subsessile yellow glands. Inflorescence leafy in lower part. Perianth segments (4)5, 1–1.3 mm, free, with scattered simple hairs and glands, somewhat swollen near midrib, with a short, white or reddish mucro at the tip. Pericarp whitish, minute-papillate, separating from the seeds. Seeds reddish, subspherical, 0.65–0.85 mm.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya & Tibet (India, Nepal, China). Probably rare in Nepal.

**Habitat:**—Gravelly slopes and ruderal sites at elevations 3400–4700 m (Uotila 2013).

**Phenology:**—Flowering August–September, fruiting September–October.

**Specimens examined** (mapped by Uotila 2013):—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang distr., Chalungpa, Lower Jeula forest, 28°54'N, 83°45'E, 3410 m, 8 September 2001, *Miehe et al. 01-119-03* (KAS).

**3. *Dysphania neglecta*** Sukhor. (Sukhorukov, 2014: 347).

Type:—NEPAL. [Karnali zone]: Far West Nepal, Jumla prov. [distr.], Jumla town, 29°16'28''N, 82°11'01''E, weed in the city, 2400 m, 23 September 2013, *Sukhorukov 241* (holotype BM-000832632!, isotype MW!) (Fig. 11).

**Description:**—Annual up to 80 cm tall, green, very aromatic; stem, leaves and perianth segments densely covered with simple and glandular hairs; subsessile glands yellow. Lower leaves long-petiolate, up to 10 cm, pinnatifid, middle and upper leaves shorter, up to 5 cm. Inflorescence subtended by the leaves in its lower part, terminal branches up to 45 cm long and 4 cm wide, with lateral branches not exceeding it in length. Perianth of 5 almost free segments of 0.8–1.2 × 0.5 mm, with many glandular and scattered simple hairs. Pericarp entirely papillate; seeds black, with white stripes, 0.7–0.8 mm, subspherical, keeled and sometimes with grooves near the keel.

**Chromosome number:**—Not known.

**Distribution:**—North-eastern India, Nepal. Common in West Nepal, often with *D. nepalensis*.

**Habitat:**—Limestone hill slopes, roadsides at elevations (1800–)2000–3500 m.

**Phenology:**—As in *D. nepalensis* but fruiting 1–2 weeks later (October).

**Specimens examined** (Fig. 12):—WEST NEPAL. **Karnali zone**: [Jumla distr.], Uthu, E of Jumla, growing beside track, 8000 ft, 31 July 1952, *Polunin, Sykes & Williams 4970* (BM); [Jumla distr.], 15 km NE from Jumla vill., 1800 m, 28 September 2010, *Sukhorukov s.n.* (MW); Border of Jumla & Mugu distr., 1 km from Naurigar village, 2300 m, along the stream, 26 September 2013, *Sukhorukov s.n.* (G).

**4. *Dysphania bhutanica*** Sukhorukov (2012a: 171).

Type:—BHUTAN. Thimphu distr.: Lango, near Paro, frequent weed in apple and other crops, 2300 m, 29 June 1992, *Parker 7263* (holotype E-00051983! image available at http://data.rbge.org.uk/herb/E00051983).

**Description:**—Annual up to 100 cm. Stem covered with short simple hairs and subsessile, intermixed orange and yellow glands. Leaves pinnatisect, 6–9 × 2–2.5 cm, long-petiolate, their segments oblong or lanceolate, sinuate to lobed. Inflorescence up to 20 cm long, leafy at least in basal and middle parts. Perianth segments almost free, oblong, 0.6–0.7 × 0.35 mm, horizontally spreading at fruiting stage, with simple conical hairs and orange (rarely yellow) subsessile glands dorsally. Fruits subglobose, 0.6–0.7 × 0.5 mm in diameter. Pericarp entirely papillate. Seeds blackish, with small keel.


**FIGURE 11.** Holotype of *Dysphania neglecta* (BM).

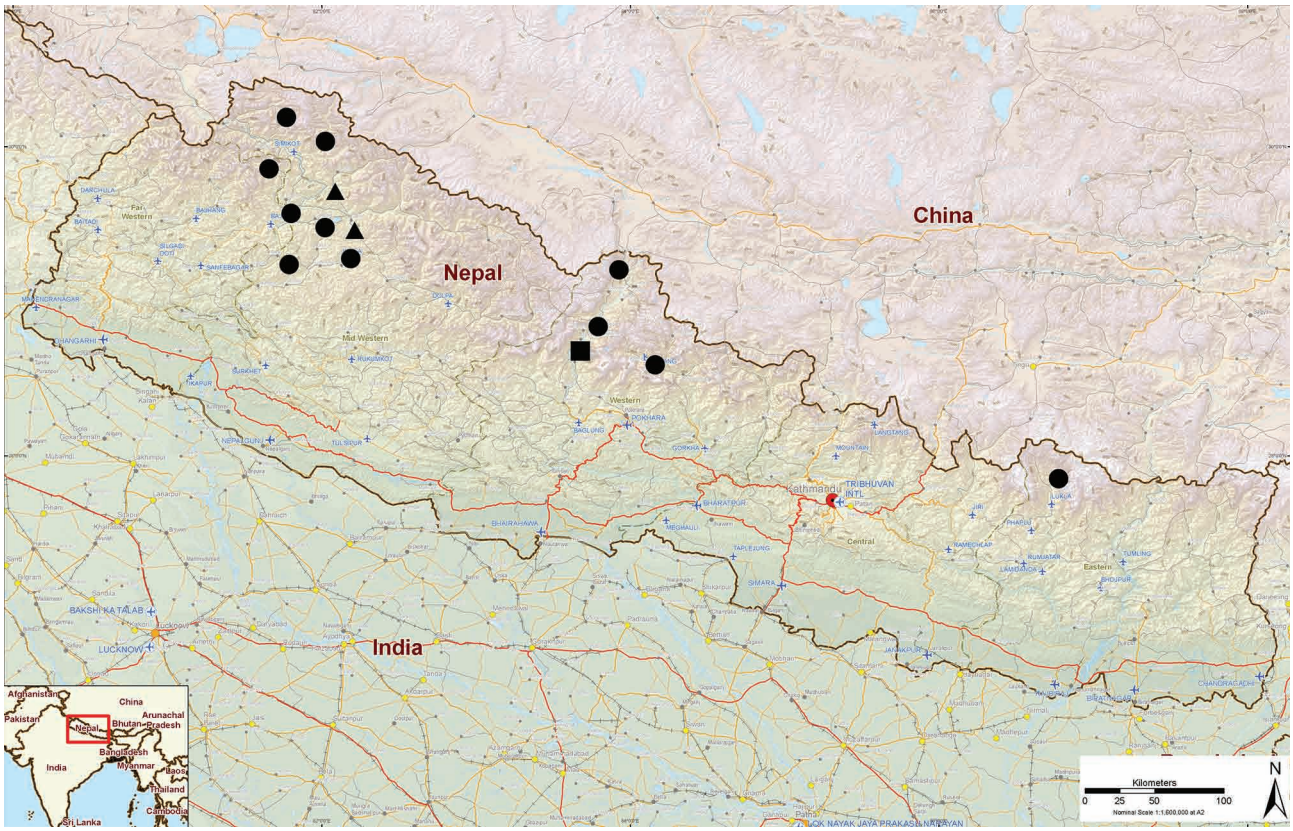


**FIGURE 12.** The distribution of *Dysphania neglecta* (triangles), *D. bhutanica* (square) and *D. nepalensis* (dots).

**Chromosome number:**—Not known.

**Distribution:**—Eastern Himalaya and south-western Tibet. Rare in Nepal.

**Habitat:**—Grassy hill slopes and disturbed areas.

**Phenology:**—Flowering June–August; fruiting July–September.

**Specimens examined** (Fig. 12):—**Dhaulagiri zone**: [Mustang distr.] Tukuche (Kali Gandaki), open grass slopes, 10500 ft, 21 August 1954, *Stainton, Sykes & Williams 7356* (BM). The plant has yellow glands only, and identification is based on the pinnatisect leaf shape.

***5. Dysphania nepalensis*** (Colla) Mosyakin & Clemants (2008: 428)

Bas.: *Chenopodium nepalense* Colla (1836: 25).

Type:—[NEPAL] ex herb. Biroli (holotype TO-5972!).

= *Chenopodium multiflorum* Moquin-Tandon (1849: 75).

Type (lectotype, designated by Sukhorukov 2012a):—[INDIA]: Ind. Orient., [Uttarakhand state] Garhwal, June 1845, *Thomson 1324* (K!, image available at http://apps.kew.org/herbcat/getImage.do?imageBarcode=K000898432; isolectotype BM-000629118!, image available at http://www.nhm.ac.uk/emu-classes/class.EMuMedia.php?irn=181039&image=yes&width=705).

**Description:**—Annual, to 50 cm, strongly aromatic, covered with simple hairs (especially the stem), glandular hairs and yellow glands. Leaves 4–10 × 2–4 cm, long-petiolate, elliptic-oblong in outline, apex rounded, pubescent mostly below. Inflorescence lax, branched, leafy or not. Cymes reduced to one sessile flower. Perianth segments 5, 0.7–0.8 × 0.4 mm, green, united at base, with scattered glands, with keel at least near the apex of the midrib, at fruiting stage open and usually persistent. Fruit subglobose, 0.7–0.8 × 0.5 mm. Pericarp hyaline, tightly adjoining the seed coat, but separating from it when rubbed, throughout with minute conical papillae up to 25 µm. Seeds dark red or almost black. Embryo horizontal.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya (southwards to Yunnan), Tibetan Plateau, Pamir Mountains. Widespread in Nepal.

**Habitat:**—Grassy hill slopes, disturbed places; 2400–4000 m.

**Phenology:**—Flowering June–September, fruiting August–November.

**Specimens examined** (Fig. 12):—WEST NEPAL. **Seti zone**: [Bajura distr.] Kolti [vill.], 5000 ft, September 1963, *Raj Bhandary 1222* (CAL). **Karnali zone**: [Mugu distr., surroundings of Rara Lake] Gum Garhi, 2400 m, 5 July 1977, *Shrestha & Manandhar 241* (E 00214393); Kalikot distr., 7 August 1991, *Takayama & Terada 9160336* (BM); Humla distr., Humla, *anonym s.n.* (KATH); Humla distr., Thanke Khola, east of Pipilang, south west facing slope, 29°44'N, 82°2'E, 1700 m, 14 July 2008, *Pendry et al. A141* (E-00392110); [Jumla distr.], Jumla village, 29°17'N, 82°05'E, 2400 m, 3 October 2010, *Sukhorukov 464* (MW, W2011-0006543, E-00607768); Mugu distr., 5 km SW of Rara Lake, 2500 m, 22 September 2013, *Sukhorukov 729* (G, MW). CENTRAL NEPAL. **Dhaulagiri zone**: Mustang [distr.], 13000 ft, 3 August 1954, *Stainton, Sykes & Williams 2165* (BM); Tegar (N of Mustang), 13500 ft, 6 August 1954, *Stainton, Sykes & Williams 2248* (BM); [Manang distr.] Marsyangdi valley, between Pisang and Ongre, 3200 m, 25 September 1969, *Wraber 36508* (BM); Cha Lungpha, near Sangda, 13200 ft, 6 August 1977, *Miehe 434* (BM); Mustang distr., Annapurna Conservation area, trekking route Jomosom–Nayapul, valley of Kali Gandaki river, 2500 m, 25 September 2008, *Sukhorukov 219* (MW). EAST NEPAL. **Sagarmatha zone**: [Solukhumbu distr.] Khumbu, Paugroche, 3900–4000 m, 9 October 1962, *Poelt s.n.* (M).

## 8. *Teloxys* Moquin-Tandon (1834: 289)

Type:—*Teloxys aristata* (Linnaeus 1753: 221) Moquin-Tandon (1834: 289) (holotype).

**Description:**—Annual up to 25 cm forming tumble-weed habit, non-aromatic, much branched from the base, glabrous or with short simple hairs. Leaves to 6 cm, narrowly oblong or spatulate, sessile or with petiole-like base, entire, folded on the ventral side. Inflorescences usually terminate with aristae, sometimes (in wet habitats) without acicular apices; flowers solitary in the axils of false-dichotomous branches. Perianth segments 5, free at base, with slightly keeled midrib, hyaline or pinkish, glabrous. Styles 2(3). Fruits 0.7–0.8 mm, compressed-spherical. Pericarp tightly adjoining the seed coat, separating from it when rubbed, without papillae. Seeds reddish-black; testa 12–15 μm thick. Embryo horizontal, rarely oblique or vertically oriented.

**Notes:**—One species; distributed mostly in Central Asia and alien in many parts of temperate Eurasia and North America.

### 1. *Teloxys aristata* (Linnaeus 1753: 221) Moquin-Tandon (1834: 289).

Bas.: *Chenopodium aristatum* Linnaeus (1753: 221).

Type (lectotype, designated by Iamonico & Jarvis 2012):—Herb. Linn. 313.24 (LINN!, image available at http://linnean-online.org/3149/).

= *Chenopodium virginicum* Linnaeus (1753: 222).

Type (lectotype, designated by Reveal in Jarvis (2007):—Herb. Linn. 313.25 (LINN, image available at http://linnean-online.org/3150/). A form of *T. aristata* without aristae.

**Description:**—See the genus description.

**Chromosome number:**—2n=18 (Probatova *et al.* 2004, Bhargava *et al.* 2007).

**Distribution:**—Central Asia, alien and ephemerophyte in many temperate regions of Eurasia and North America.

**Habitat:**—Gravelly substrates at elevations 3000–4000 m. A rare plant; not observed by Sukhorukov in 2008–2010 at the site given below.

**Phenology:**—Flowering July–September, fruiting August–October.

**Specimens examined** (Fig. 13):—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang distr., Khinga, 21 August 1994, 3180 m, *Noshiro et al. 9485511* (E); the same site, 24 September 1994, *Nakarmi 180/1994* (TUCH).

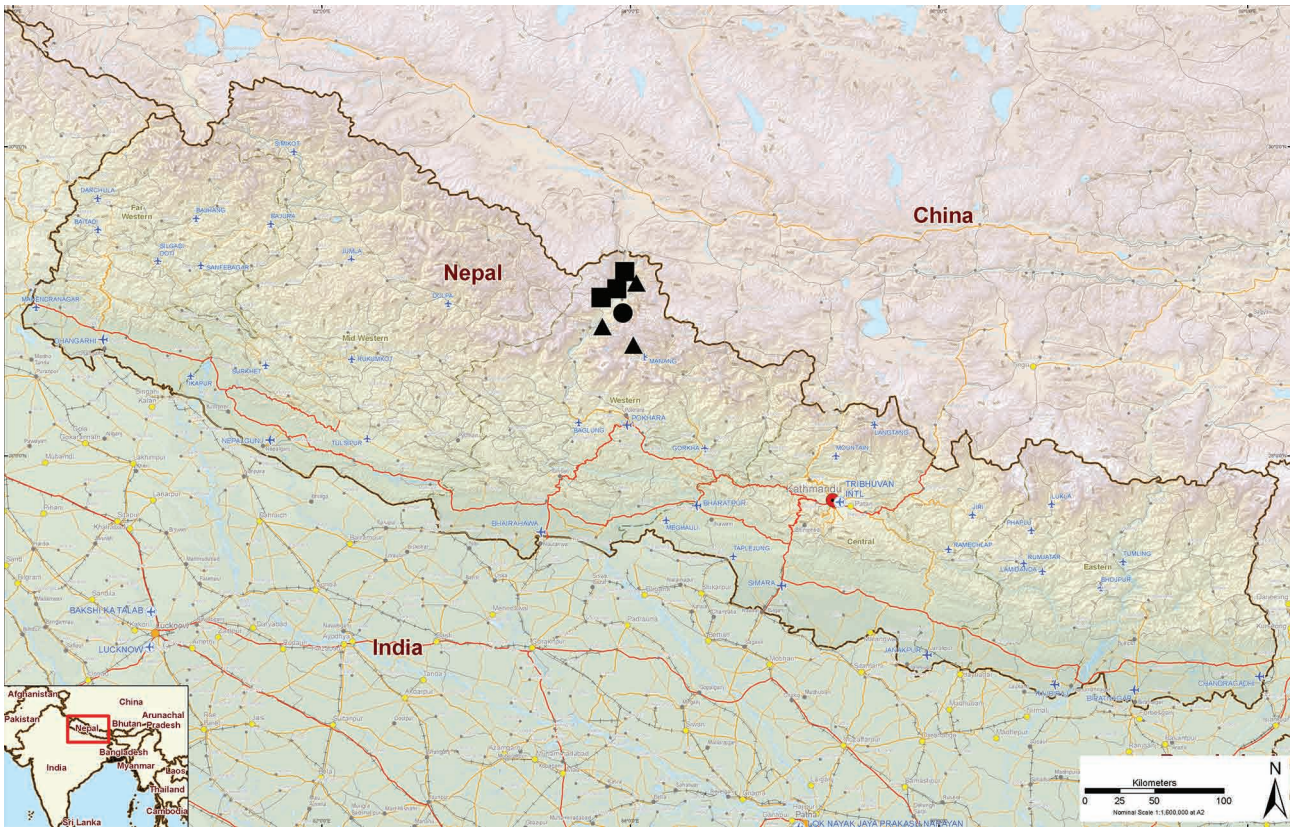


**FIGURE 13.** The distribution of *Teloxys aristata* (dot), *Axyris prostrata* (squares) and *Krascheninnikovia ceratoides* (triangles).

## Tribe Axyrideae G. Kadereit & Sukhor. (Kadereit & al. 2010: 1682)

### 9. *Axyris* Linnaeus (1753: 979).

Type (lectotype, designated by Jonsell & Jarvis in Jarvis *et al.* 1993):—*Axyris amaranthoides* Linnaeus (1753: 979).

**Description:**—Monoecious annuals covered with stellate hairs sometimes intermixed with simple multicellular hairs. Leaves short- or long-petiolate, blade ovate, oblong, spatulate or lanceolate, entire, rarely crisp. Male flowers arranged in terminal spike-like inflorescences up to 8 cm long, with minute perianths of 3–5 free hyaline segments; female flowers located in the bract axils with two bracteoles which look like a perianth. Fruits always dimorphic (heterocarpous), with the pericarp tightly adjoining the seed coat with small ear-like appendages at the apex of the fruit. Seeds also dimorphic (with thick and thin seed-coat testa). Embryo vertical, horseshoe-shaped or annular; perisperm present.

**Notes:**—Six species in Eurasia, predominantly in Central Asia. The fruit morphology and anatomy as well as peculiarities in the plant pubescence have been considered the most valuable characters for delimiting *Axyris* species (Sukhorukov 2005, 2011).

#### Key to the species

1. Plant with prominent main stem; branches ascending; brown fruits (1.6−)2–2.4 mm, not curved .....1. *A. mira*
- Plant without pronounced main stem, all branches prostrate; brown fruits 1.3–1.8(−2.2) mm, curved, pear-like ... . 2. *A. prostrata*

#### 1. *Axyris mira* Sukhor. (Sukhorukov 2011: 76).

Type:—[INDIA]. [Uttarakhand state]: Kumaon, Milam glacier, 12500 feet above the Sea, 28 August 1848, *Strachey & Winterbottom 2* (holotype LE!).

**Description:**—Annual, to 40 cm, erect, stem at least in its upper part densely covered with both short- and long-rayed stellate hairs. Leaves short-petiolate, oblong or ovate, to 6 × 2 cm, with short-rayed stellate hairs, dark green. Male inflorescence up to 3 cm. Perianth of the female flowers with dense and large simple hairs. Black fruits 1.5–1.8 mm, possessing very small (up to 0.15 mm) appendices of the pericarp, in most cases indistinct; brown or reddish brown fruits (1.6−)2–2.4 mm.

**Chromosome number:**—Not known.

**Distribution:**—Himalaya and Tibet. Scattered in Nepal.

**Habitat:**—Grassy (sub)alpine vegetation, sometimes ruderal sites at elevations 2600–4000 m.

**Phenology:**—Flowering August–September, fruiting September–early November.

**Specimens examined** (mapped by Sukhorukov 2011):—WEST NEPAL. **Karnali zone**: [Mugu distr.] Karnali valley, between Mangri and Daura, 8500 ft, 16 August 1952, *Polunin, Sykes & Williams 5251* (BM, E). CENTRAL NEPAL. **Dhaulagiri zone**: Mustang [distr.], 15000 ft, 5 August 1954, *Stainton, Sykes & Williams 2190* (BM). **Gandaki zone**: Manang prov.[distr.], Marsyandi valley, between Pisang and Onigre, 3200 m, 25 September 1969, *Wraber 403 & 36504* (BM); [Manang distr.] Braga–Thorong pass, 11000 ft, November 1978, *Davis 115* (K); Manang distr., Yak-Kharka, 3850 m, 17 August 1994, *Mikage et al. 9460382* (BM, E-00156347). EAST NEPAL. **Mechi zone**: [Taplejung distr.] Talung, 2600 m, 3 October 1971, *Dobremez 71-25* (E-00014374).

### 2. *Axyris prostrata* Linnaeus (1753: 980).

Type (lectotype, designated by Sukhorukov 2005):—Herb. Linn. 1101.6 (LINN!, image available at http://linnean-online.org/10715/) The synonymy is given by Sukhorukov (2005).

**Description:**—Annual with several prostrate stems up to 25 cm, at high elevations (4000–4500 m) the plant often has a pincushion habit with small branches and short internodes. Leaves spatulate, up to 3 cm, entire, with long-rayed stellate hairs near the leaf base, substituted in other parts by short-rayed hairs. Male inflorescence up to 2 cm. Perianth of the female flowers with sparse simple hairs. Black fruits 1.8–2.2 mm, with hardly noticeable or indistinct ear-like appendices; brown fruits 1.3–1.8(−2.2) mm.

**Chromosome number:**—2n=36 (Lomonosova & Krasnikov 1993).

**Distribution:**—Central Asia, Siberia, Himalaya and Tibet. One of the widespread *Axyris* species. Rare in Nepal.

**Habitat:**—Stony places, alpine vegetation.

**Phenology:**—Flowering August–September, fruiting September–October.

**Specimens examined** (Fig. 13):—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang [distr.], 14500 ft, 5 August 1954, *Stainton, Sykes & Williams 2194* (BM, E). Two other records from Upper Mustang are reported by Yonekura (2008) (n.v.).

## 10. *Krascheninnikovia* Gueldenstaedt (1772: 551)

Type:—*Krascheninnikovia ceratoides* Gueldenstaedt (1772: 555) (holotype).

**Description:**—Subshrubs or shrubs, up to 200 cm. Stem and leaves covered with stellate hairs often turning fulvous when dry. Leaves alternate, short-petiolate, entire, linear, oblong or ovate, green. Flowers unisexual (plants monoecious); male flowers agglomerated in dense spike-like inflorescences that terminate the branches, perianth hyaline, of 3–5 almost free segments covered with stellate but easily caducous indumentum; female flowers below the male ones, in the bract axils, enclosed in a cover consisting of 2 connate accrescent bracts covered with long simple hairs and much smaller stellate hairs. Styles 2. Fruits with hyaline, very thin pericarp covered with scattered stellate hairs. Seeds ca. 2 mm, with thin seed coat, with perisperm and vertical horseshoe-shaped embryo.

**Notes:**—One species in the deserts of Eurasia and North America. According to recent investigations (Heklau & Röser 2008), the genus comprises 1 species divided into several subspecies.

### 1. *Krascheninnikovia ceratoides* (Linnaeus) Gueldenstaedt (1772: 555).

Bas.: *Axyris ceratoides* Linnaeus (1753: 979).

Type (lectotype, designated by Hedge 1997):—Herb. Linn. 1101.1 (LINN!, image available at http://linnean-online.org/11529/).

The synonymy is given by Heklau & Röser (2008).

**Description:**—See the genus description.

**Chromosome number:**—2n=36 (Dobeš & Hahn 1997).

**Distribution:**—Widely distributed in the steppes, deserts and alpine vegetation of Eurasia. Often dominant in gravelly high-elevation deserts in Nepal.

**Habitat:**—Gravelly hill slopes and cold deserts at the elevation 2700–4200 m.

**Phenology:**—Flowering July–September, fruiting September–October.

**Specimens examined** (Fig. 13):—CENTRAL NEPAL. **Dhaulagiri zone**: Mustang distr., Muktinath, 11500 ft, 25 June 1954, *Stainton, Sykes & Williams 1398* (BM, E, LE); Damodar Kund (N of Muktinath), 31 July 1954, *Stainton, Sykes & Williams 2107* (BM); Yara (S of Mustang), 12000 ft, 2 August 1954, *Stainton, Sykes & Williams 2134* (BM, E); Mustangbhot, 29°11'N, 83°58'E, 3500 m, 22 August 1956, *Lobbichler s.n.* (BM); [Mustang distr.] Ghiling, 29°0'N, 83°52'E, 3800 m, 17 May 1974, *Dobremez 3008*, (E-00214385, BM); Mustang [distr.], Bara Gaon, 16 July 1998, *Sykes 336/98* (E-00649123); Mustang [distr.], Lo Tsho Dyun, Tangbe (Tangya) area, 18 July 1998, *Sykes 317/98* (E-00647146); Mustang [distr.], Bara Gaon, Kagbeni area, 31 August 1998, *Sykes 306/98* (E-00649111); Mustang distr., Chuksang (2970 m), Tetang (3000 m), Gnyu Pass (4100 m), 28°55'N, 83°49'E–28°51'N, 83°51'E, 13 July 2000, *Iokawa et al. 20020158* (E-00246125); Mustang distr., Dhi to Lo La, 3880 m, 14 August 2001, *Noshiro et al. 20103048* (E-00238916).

## Subfam. Betoideae Ulbrich (1934: 455)

## 11. *Acroglochin* Schrader (1822: 69)

Type:—*Acroglochin chenopodioides* Schrader (1822: 227) (holotype) [=*A. persicarioides* (Poiret 1810: 311) Moquin-Tandon (1849: 254)].

**Description:**—Glabrous or scarcely pubescent annual up to 50(−70) cm, branches often terminating in aristae. Leaves long-petiolate, to 10 cm, broadly ovate or ovoid, dentate, sparsely covered with simple, often curved hairs. Inflorescence in the leaf axils, quite short, falsely dichotomous. Perianth of 5 free segments, keeled along midrib. Stamens 2, anthers small, 0.2–0.3 mm, without appendages. Stylodia concrescent into column in their lower half. Fruit dehiscent by a lid; pericarp whitish, of several homocellular layers. Seeds depressed-globular, ca. 1.3 mm in diameter, smooth.

**Notes:**—One species in Himalaya and West China.

### 1. *Acroglochin persicarioides* (Poiret) Moquin-Tandon (1849: 254).

Bas.: *Amaranthus persicarioides* Poiret (1810: 311).

Type:—Not designated.

= *Acroglochin chenopodioides* Schrader (1822: 227).

Type:—Not designated.

= *Boehmeria amarantus* Léveillé (1913: 550).

Type:—CHINA. Kouy-Tcheou [Guizhou] prov., environs de Gan-Pin, 29 August 1897, *Martin & Bodinier s.n.* (holotype E-00317870!).

**Description:**—See the genus description.

**Chromosome number:**—2n=36* (Lomonosova *et al.* 2012).

**Distribution:**—Himalaya and Tibet. Common in Nepal, 2000–2500 m.

**Habitat:**—Hill slopes, disturbed areas at elevations (1700)2000–2500(3000) m.

**Phenology:**—Flowering July–September, fruiting August–October.

**Specimens examined** (Fig. 14):—WEST NEPAL. **Karnali zone**: [Mugu distr.] Mugu Khola, between Daura and

Mugu, 10000 ft, 17 August 1952, *Polunin, Sykes & Williams 5275* (E); [Jumla distr.] Bharbhare village, 25 September 2010, *Sukhorukov 421* (MW); Jumla distr., Jumla village, 29 September 2010, *Sukhorukov s.n.* (MW, E); [Mugu distr.] Bhota village, 2300 m, 1 October 2010, *Sukhorukov 56* (MW); CENTRAL NEPAL. **Dhaulagiri zone**: many sheets from Mustang distr., surroundings of Jomosom and Marpha villages (BM, E, MW*).

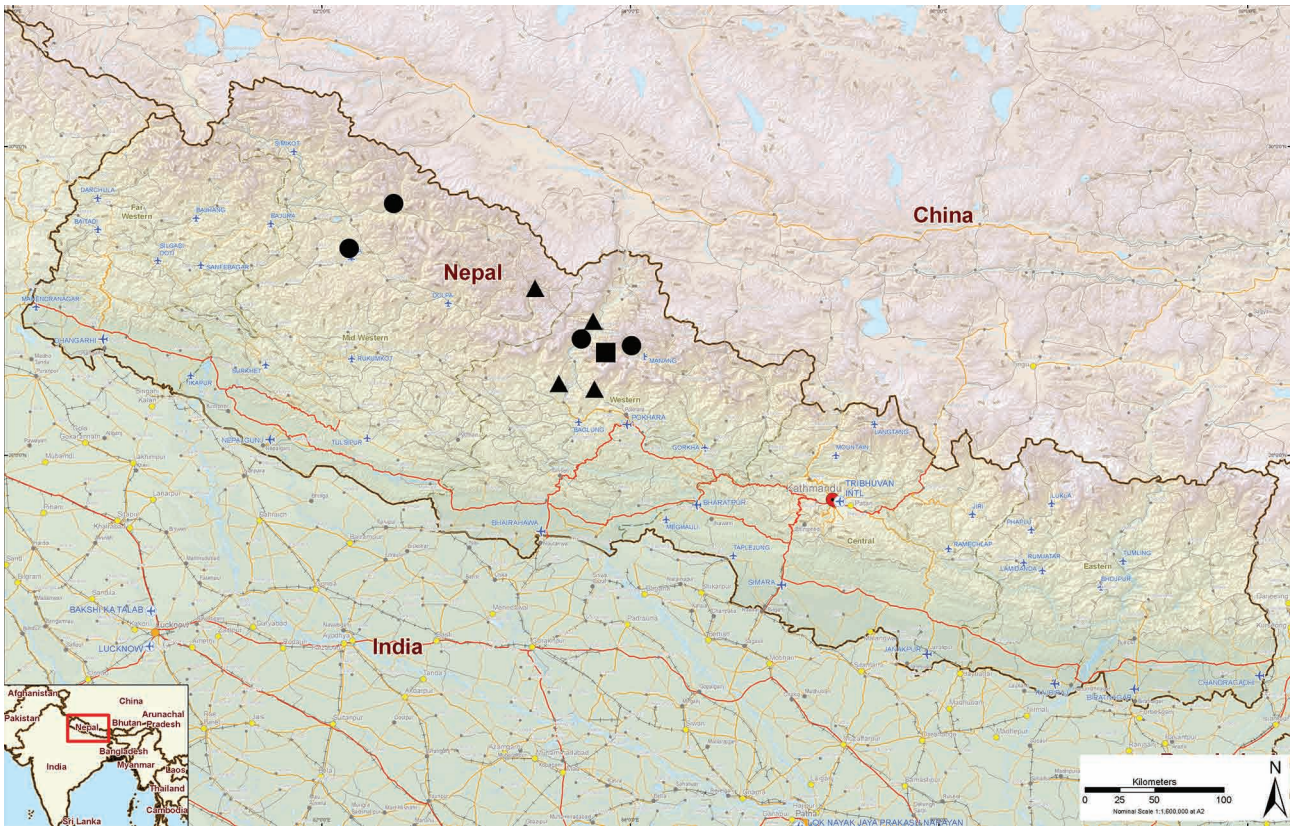


**FIGURE 14.** The distribution of *Acroglochin persicarioides* (dots), *Bassia scoparia* (square) and *Kali jacquemontii* (triangles).

## Subfam. Camphorosmoideae Scott (1978b: 102)

### 12. *Bassia* Allioni (1766: 177)

Type:—*Bassia muricata* Ascherson in Schweinfurth (1867: 187) (holotype).

**Description:**—Annuals or subshrubs with simple, alternate, flattened and entire or terete leaves with diverse types of kranz-anatomy. Inflorescence spiciform, leafy, formed of few-flowered axillary clusters. Flowers solitary or 2–5 in clusters, hermaphrodite or unisexual (mostly female), with 5 perianth segments which are free or connate half-way, and which develop wing-like, spiny or tuberculate outgrowths in the fruiting stage, or rarely lack outgrowths. Ovary round; style very short, with 2–3 filiform stigmas. Fruit round or ovoid, compressed, with smooth pericarp tightly adjoining the seed coat; seeds with horizontal or vertical horseshoe-shaped embryo; perisperm abundant.

**Notes:**—The genera that are now included in *Bassia* are cited in Kadereit & Freitag (2011).

About 20 species in Europe, Asia and North Africa.

1. ***Bassia scoparia*** (Linnaeus) Scott (1978b: 89).

Bas.: *Chenopodium scoparium* Linnaeus (1753: 221).

Type (lectotype, designated by Jafri & Rateeb 1978):—Herb. Linn. 313.20 (LINN!, image available at http://linnean-online.org/3145/).

≡ *Kochia scoparia* (Linnaeus) Schrader (1809: 85).

Other synonyms are given in Sukhorukov (2014).

**Description:**—Erect annual up to 150 cm; stem and branches green or sometimes reddish, moderately to densely clothed throughout in long, soft, simple, multicellular hairs. Leaves flat, those of main stem and lower parts of branches 20–50(−80) × 1.5–7(−10) mm, subpetiolate at base, narrowly oblong to lanceolate or linear, 3-nerved, densely pilose; bracts longer than flower clusters. Inflorescences spiciform, foliose, axis with fine spreading hairs; flowers mostly in clusters of 2–5, unisexual or hermaphrodite, surrounded by basal tufts of hairs or not. Perianth fused to half-way, ciliate or glabrous, at the fruiting stage with small horizontal wings or tubercles, sometimes without any projections. Fruit ca. 2 mm in diameter, compressed-ovoid, dark brown.

**Chromosome number:**—2n=18* (Lomonosova *et al.* 2012).

**Distribution:**—Originated probably in Central Asia (Kazakhstan to West China and Mongolia), alien elsewhere in the temperate parts of Eurasia and America.

**Habitat:**—Disturbed areas at elevations 2600–3500 m; rare.

**Phenology:**—Flowering July–September, fruiting August–October.

**Specimens examined** (Fig. 14):—CENTRAL NEPAL. **Dhaulagiri zone**: [Mustang distr.] Tukuche, Kali Gandaki, 8500 ft, 12 June 1954, *Stainton, Sykes & Williams 1072* (BM); Mustang [distr.] Jomosom village, 2800 m, 26 September 2009, *Sukhorukov s.n*. (E, MW*).

## Subfam. Salsoloideae Rafinesque (1837: 45)

### 13. *Kali* Miller (1754: 715)

Type:—*Kali turgidum* Gutermann (2011: 98) (holotype).

**Description:**—Annuals or subshrubs, glabrous or with papillae. Leaves mostly alternate, or lower leaves opposite, semi-terete or terete, stiff or (lower leaves) fleshy, with a persistent yellowish mucro up to 3.5–4 mm. Bracts longer than bracteoles or equal in size. Flowers axillary, solitary or in clusters of 2–3. Perianth segments 5, hyaline or membranous, in the fruiting stage sometimes hardened, mostly with tubercules or wings. Stamens 5, without prominent appendages at the tip of the anthers. Stigmas 2. Fruits dry; seeds with horizontal embryo; perisperm absent.

**Notes:**—About 15 species in the steppes and deserts of Eurasia.

**1. *Kali jacquemontii*** (Moq.) Akhani & Roalson (2007: 946).

Bas.: *Salsola jacquemontii* Moquin-Tandon (1849: 188)

Type (lectotype, designated by Rilke in Freitag & Rilke 1997):—In India orientali, *V. Jacquemont 2114* (P-00163982, image available at http://science.mnhn.fr/institution/mnhn/collection/p/item/p00163982).

= *Salsola nepalensis* Grubov (1961: 127).

Type:—NEPAL. [Karnali zone]: [Dolpa distr.] below Rohagaon, Suli Gad, 8500 ft, growing among shrubs on dry slopes, 13 September 1952, *Polunin, Sykes & Williams 3357* (holotype LE, iso BM-000016772!, image available at http://www.nhm.ac.uk/emu-image-download/class.EMuMedia.php?irn=178999&image=yes&width=705).

**Description:**—Annual to 40 cm, with prostrate habit or rarely with prominent stem; stem and branches green or reddish, covered with papillae throughout. Lower leaves up to 3 × 0.1 cm decreasing in size towards up the stem, semiterete, forming in their axils stout 2-flowered clusters subtended by concrescent bracts and bracteoles hardly exceeding the perianth (the perianth segments in these 2-flowered clusters form small wings or tubercles at fruiting stage). Bracts 0.5–1 cm, stout. Flowers in main inflorescence arranged in spikes; perianths white or pink, at the fruiting stage with small wings (4.5–5.5 mm across), segments above the wings hyaline, ciliate, narrowly triangular, forming conus. Fruits ca. 1.5 mm; pericarp smooth; seed with translucent coat.

**Chromosome number:**—2n=18* (Lomonosova *et al*. 2012).

**Distribution:**—Himalaya, Tibet.

**Habitat:**—Gravelly substrates, limestone at elevations 2600–4200 m.

**Phenology:**—Flowering July–September, fruiting August–October.

**Specimens examined** (Fig. 14):—WEST NEPAL. **Karnali zone**: [Dolpa distr.] Saldanggam, Chharkabhot,

15500 ft, 24 June 1952, *Polunin*, *Sykes*, *Williams 1199* (BM); [Dolpa distr.], below Rohagaon, Suli Gad, 8500 ft, 13 September 1952, *Polunin*, *Sykes & Williams 3357* (type of *Salsola nepalensis*). CENTRAL NEPAL. **Dhaulagiri zone**: [Mustang distr.] Kagbeni, 10000 ft, 8 June 1954, *Stainton, Sykes & Williams 5660* (BM); [Mustang distr.], Thinigaon, Mukhtinath Himal, 11500 ft, 24 June 1954, *Stainton, Sykes & Williams 1369* (BM; LE); [Mustang distr.] Yara (S of Mustang), 12000 ft, 2 August 1954, *Stainton, Sykes & Williams 2131* (BM); [Mustang distr.] Kali Gandaki, near Marpha, 8500 ft, 15 July 1977, *Miehe 165* (BM); Cha Lungpha, 10000 ft, 31 August 1977, *Miehe 563* (BM); Mustang distr., 3280 m, 26 September 1995, *Mikage et al. 9552530* (BM); [Mustang distr.] Kagbeni (2810 m)–Tangbe (3050 m)–Chuksang (2970 m), 28°50'N, 83°47'E–28°55'N, 83°49'E, 9 July 2000, *Iokawa et al. 20020016* (E-00246126); [Mustang distr.] near Kagbeni vill., 3000 m, 23 September 2009, *Sukhorukov s.n.* (MW*).

## Discussion

### Progress in understanding the taxonomic diversity of *Dysphania*

In the past *Dysphania* was part of the large genus *Chenopodium* subgen. *Ambrosia* (e.g. Scott 1978a). However, *Chenopodium* appeared to be polyphyletic and was split into several lineages following molecular investigations (Kadereit *et al.* 2003, 2010, Fuentes-Bazan *et al.* 2012a). Many smaller groups confirmed in their generic status or described as new for science are clearly distinct in their morphological (Fuentes-Bazan *et al.* 2012b) or especially carpological (Sukhorukov & Zhang 2013, Sukhorukov *et al.* 2013) traits. The most significative characters of the tribe *Dysphanieae* are the occurrence of simple hairs often intermixed with glandular hairs and subsessile glands, a special set of trichomes on the pericarp surface, and the absence of stalactites in the testa cells (Sukhorukov 2014). The emergence of the subsessile glands is the most indicative character of the type genus *Dysphania*. The set of carpological characters is quite unique for Australian, American and Eurasian-African representatives, and only a few American species show the morphological and carpological similarities to Eurasian and African species (Sukhorukov 2012b), and these data are confirmed by the molecular phylogeny (Kadereit *et al.* in prep.).

*Dysphania botrys* was considered for a long time to be the only native species in arid and mountainous parts of Eurasia [e.g., Hooker 1890, Bamber 1916, Aellen &Iljin 1936, Long 1984, Press *et al.* 2000 (sub *Chenopodium botrys*), Zhu *et al.* 2003 (excl. *Dysphania aristata*)]. In short time the number of recognized indigenous species in the Himalaya and Tibet has been drastically increased up to seven: *D. bhutanica*, *D. botrys*, *D. himalaica*, *D. kitiae* Uotila (2013: 75), *D. neglecta*, *D. nepalensis*, *D. tibetica* (A.J. Li) Uotila (2013: 67), all of them belonging to *Dysphania* sect. *Botryoides* (Meyer 1829: 410) Mosyakin & Clemants (2002: 383). Such rapid progress in the knowledge of *Dysphania* biodiversity is connected with a better understanding of the morphological and carpological characters of each species. Among all the taxa known in the Himalaya and Tibet, only *D. himalaica* with (sub)entire leaf blades and vertical embryo position, and *D. tibetica,* which has branches mostly terminating in aristae and which bears in some circumstances ovoid (not globular) fruits with an unusual brownish seed coat, are clearly distinguished from the other members of the group. In other species, only a limited number of characters are useful in their diagnostics, and most of them are based on reproductive traits: diverse indumentum on the perianth or small differences in the shape of papillae on the pericarp surface seen in SEM (compare Sukhorukov 2012a, 2012b, Uotila 2013, Sukhorukov & Zhang 2013). The recent data indicate that each species is characterized by a different distribution area within Eurasia. Only two taxa (*D. botrys* in the arid territories of Irano-Turan, and *D. nepalensis* in the Himalaya and Tibet) have more extended ranges (Sukhorukov 2012a, Uotila 2013). *D. kitiae* was known only of a few specimens from European herbaria (Uotila 2013), but for the first time it was described as *Chenopodium aristatum* f. *muticum* J.Q. Fu (Fu, 2000: 610), with two types cited [lectotype, here designated: Shansi prov., Wuqi County, alt. 1200 m, 13 September 1984, *Yang Jinxiang 5115* (WUK!)]. Here we map the records of *D. kitiae* known at present, mostly based on re-identified specimens in Chinese herbaria (see Appendix). It now seems to be widely distributed in the provinces Gansu, Hebei, Shansi, Shaanxi, Qinghai, Yunnan and Sichuan, and has the most eastern range among the Eurasian species of *Dysphania* (Fig. 15). In addition to the description provided by Uotila (2013), this species is easily recognized by the slightly recurved inflorescence branches with compactly arranged flowers and by the perianth indumentum (yellow subsessile glands and scattered simple trichomes, Fig. 16).

On the basis of all these data we can conclude that *Dysphania* has the richest taxonomic diversity in Himalaya and Tibet as expressed in the presence of 7 native taxa. The additional two *Dysphania* species in Asia are the widespread *D. ambrosioides* in the tropical part and lower mountainous belt, and the very rare *D. schraderiana* (Schultes 1820: 260) Mosyakin & Clemants (2002: 383) of African origin in north-western Himalaya (Uotila 1997, 2001b).

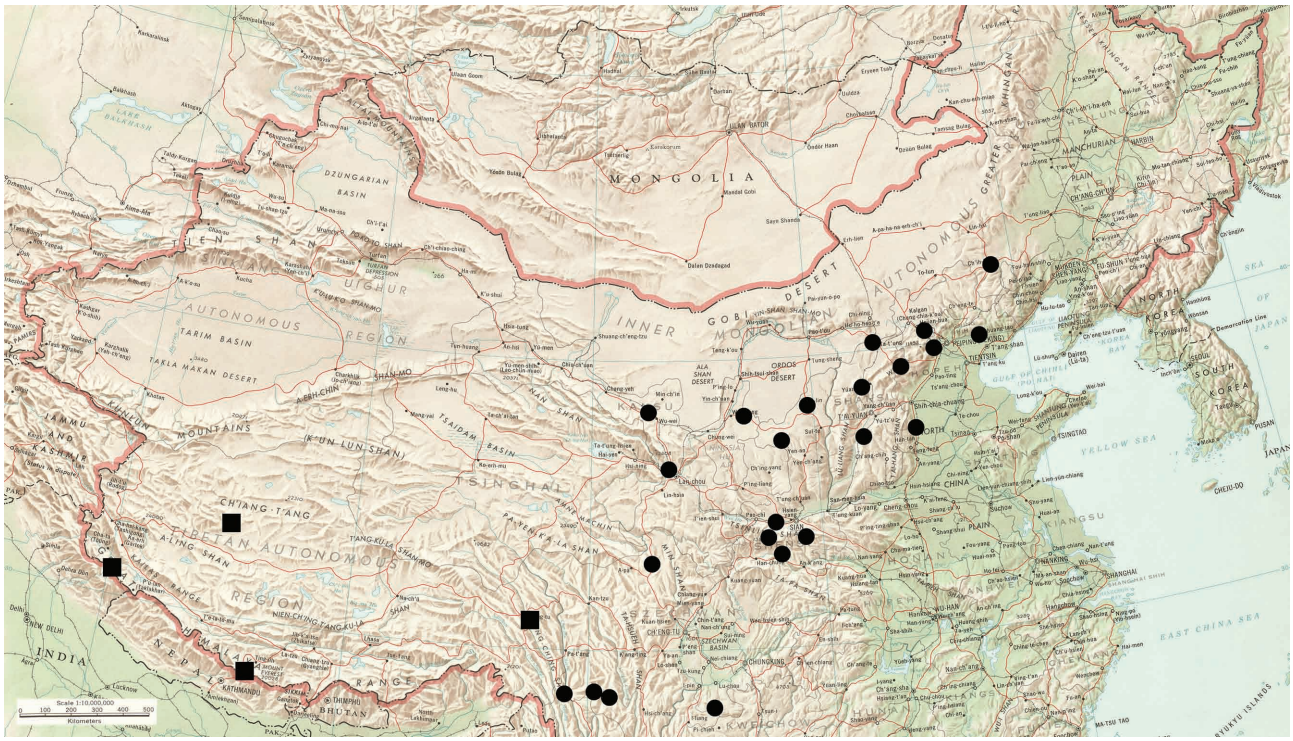


**FIGURE 15.** The general distribution of *Dysphania kitiae* based on the herbaria PE and WUK (dots) and *Chenopodium perttii* outside of Nepal (squares).

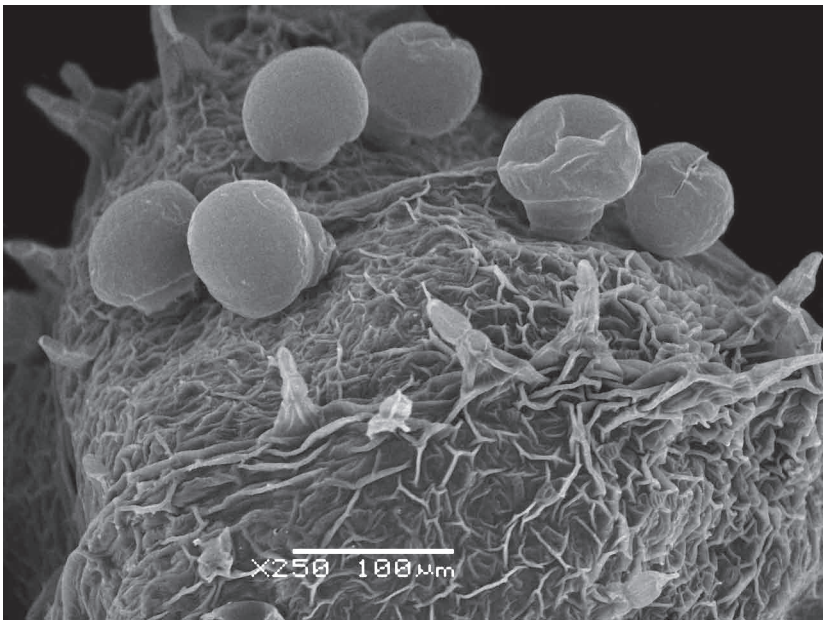


**FIGURE 16.** The perianth of *Dysphania kitiae* with subsessile glands and scattered simple hairs [voucher: China, Sichuan prov., October 1914, *Handel-Mazzetti s.n.* (W)]. Scale bar—100 µm.

**Additional taxa of Chenopodiaceae expected from Nepal**

On the basis of the distribution maps provided, it can be seen that the most records are from the most visited parts of Central Nepal (surroundings of Kathmandu and locations in Mustang district), as well as some places in West Nepal (especially in Jumla district). Also the new species for science described from this country (at least those with exact geographical coordinates) come from provinces in western (*Dysphania neglecta*) or central [*Salsola nepalensis* (= *Kali jacquemontii*), *Chenopodium perttii*] parts of Nepal. We expect that further native species will be discovered in the future in other locations, especially along the main Himalayan range.

In the past only one additional species [*Chenopodium atripliciforme* Murr (1902: 360)] was reported from Nepal

(Press *et al.* 2000). This remarkable taxon with its triangular leaf shape is distributed in North India, northern Pakistan and Afghanistan (Uotila 1997), but it does not apparently occur in north-eastern Indian states close to the Nepali border. The most predictable taxa are *Dysphania tibetica* (Uotila 2013) and *Corispermum nanum* Sukhor. & Zhang (Sukhorukov *et al.* 2014: 84) found in West Tibet near Nepali territory. The Terai region of Nepal may include some *Chenopodium* species recently described (Pandeya & Pandeya 2003) and accepted in Paul's (2012) treatment of Indian Chenopodiaceae, but the composition of this genus in tropical part of India has been very poorly studied so far and requires additional investigation.

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## Appendix. Specimens of *Dysphania kitiae* re-identified in the herbaria visited:

**Gansu** prov.: Lanzhou county, 27 September 1956, *Expedition team s.n*. (PE-00510830); Yongchang county, near Wu-wei, 1958, *anonym s.n*. (PE); Yongdeng, Liancheng, 2999 m, 14 September 1958, *Ganqing Team Zhong Buqiu 10147* (WUK). **Ningxia** prov.: Yanchi, Yangliubu, 1310 m, 18 September 1984, *Yang Jinxiang 5222* (WUK). **Inner Mongolia** prov.: Rehe Chifeng vincinity (Zhifang Village), 570 m, 21 September 1952, *Liou Tchen-ngo 5220* (WUK); Fengzhen, Xuegangshan Mountains, 1230 m, 28 September 1984, *Huangtu Team (Jin) 4197* (WUK). **Hebei** prov.: Lingshankou, Choluhsien, 7 September 1930, *Hsia 2448* (PE-00510747); Eastern Tombs, 16 September 1930, *Liou 1603* (PE-00510746); Neiqiu County, Xiaolingdi village, Bulaoqing, 16 September 1950, *Liu Ying 13801* (PE); [near Beijing] Baihuashan, Huang'antuo, 19 September 1950, *Wang Wen-cai 744* (PE); Huailai county, Zhaojiapeng, Tianqiaoshan, 19 September 1959, *anonym 172* (PE). **Shansi** prov.: Luyashan, Ning-wu, 5000 ft, 20 August 1929, *Hsia 1616* (PE-00510771); Chieh-hsiu [Jiexiu] distr., Sung-Lin-miao, in cultis, ca. 800 m, 3 October 1924, *Smith 7899* (PE-00510602); Sihsien, Shikowtze, 1500 m, 3 September 1935, *Wang 3449* (PE-00510781); Shangchuang, Sihsien, 1200 m, 12 September 1935, *Wang 3600* (PE-00510772). **Shaanxi** [Shensi] prov.: along Wei river, 10 September 1932, *Hao 4526* (PE-00510872); Ningshen-hsien, 900 m, 19 July 1933, *Kung 3105* (PE-00510797); Tsashui Hsien [Zhàshuǐ Xiàn], 8 October 1933, *Wang 1991* (PE-00510790); Yulin, 10 August 1982, *Yang Jinxiang 3988* (PE); Wuqi County, 1200 m, 13 September 1984, *Yang Jinxiang 5115* (WUK); Zhouzhi, Taibeishan, 1500 m, 6 July 1999, *Zhu & Xu 1546* (PE-00235085). **Sichuan** prov.: Xiao, October 1914, *Handel-Mazzetti s.n.* (W); NW part, Rumichango, 2000 m, 29 October 1922, *Smith 4872* (PE-00510698); Mu-li, Ko-pa-ting, 2500 m, 17 July 1937, *Yu 7290* (PE-00510910); Sungpan [Songpan], Heihichiao, 1600 m, 23 October 1937, *Wang 7939* (PE-00510903). **Yunnan** prov.: Wei-se Hsien [Wēixìn Xiàn], 2600 m, 19 September 1934, *Tsai 57965* (PE-00510952); Tehching, Tsawalungla, 2800 m, 18 September 1937, *Yu 10331* (PE-00510961).