



## A new species of *Dysphania* (Chenopodioideae, Chenopodiaceae) from South-West Tibet and East Himalaya

ALEXANDER P. SUKHORUKOV<sup>1,2\*</sup>, MINGLI ZHANG<sup>2,3</sup> & MARIA KUSHUNINA<sup>4</sup>

<sup>1</sup> Department of Higher Plants, Biological Faculty, Lomonosov Moscow State University, 119234, Moscow, Russia; [suchor@mail.ru](mailto:suchor@mail.ru)

<sup>2</sup> Key Laboratory of Arid-land Biogeography and Bioresources, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, Xinjiang, China;

<sup>3</sup> Institute of Botany, Chinese Academy of Sciences, Beijing, China; [zhangml@ibcas.ac.cn](mailto:zhangml@ibcas.ac.cn)

<sup>4</sup> Department of Plant Physiology, Biological Faculty, Lomonosov Moscow State University, 119234, Moscow, Russia; [mkushunina@gmail.com](mailto:mkushunina@gmail.com)

\* author for correspondence

### Abstract

*Dysphania geoffreyi* is described as a new species, with records in China (Xizang and Yunnan provinces) and Bhutan. It differs from morphologically similar taxa by virtue of the clustered flowers in the inflorescence, indumentum set on the perianth, terminally concave pericarp papillae, and smaller seeds 0.5–0.6 mm in diameter. In total eight native *Dysphania* species are identified in Himalaya and Tibet, and revised distribution patterns of *D. bhutanica*, *D. himalaica* and *D. tibetica* are presented. The most significant reproductive features of all native *Dysphania* taxa are summarized.

**Key words:** Chenopodiaceae, distribution, *Dysphania*, Himalaya, new species, Tibet

### Introduction

The chenopodiaceous taxa occurring in Himalaya and Tibet have attracted a high attention during the recent years. Many species growing in this region were previously confused with other morphologically similar taxa occurring in different parts of Central Asia. In recent years, improvements have been made in the difficult genera *Axyris* Linnaeus (1753: 979) (Sukhorukov, 2011), *Chenopodium* s.str. Linnaeus (1753: 218), and *Dysphania* Brown (1810: 411) (Sukhorukov 2012a, 2012b, 2014, Uotila 2013, Sukhorukov & Kushunina 2014).

The taxonomy of *Dysphania* has been significantly changed after investigations carried out during the last decade and following the publication of the account of Chenopodiaceae for the “Flora of China” (Zhu *et al.*, 2003). All the Chinese native *Dysphania* species belong to the sect. *Botryoides* Mosyakin & Clemants (2002: 383) (Uotila 2013, Uotila *et al.* in prep.) that comprises annuals covered with several indumentum types (sessile glands, simple and glandular hairs) occurring on the free or basally united perianth segments which are opened at the fruiting stage. Other distinguishing features of *Dysphania* sect. *Botryoides* are the minute papillate pericarp, and relatively small (0.7–1.1 mm) spherical seeds. The small-scale reproductive traits provide the most significant information about the species delimitation, and they are now well-studied and used as the most important diagnostic characters at species level (Uotila 2013, Sukhorukov & Kushunina 2014).

Until now, seven species were recognized as native in the Himalaya and Tibet (Sukhorukov & Kushunina, 2014): *D. bhutanica* Sukhorukov (2012a: 171), *D. botrys* (Linnaeus 1753: 219) Mosyakin & Clemants (2002: 383), *D. himalaica* Uotila (2013: 68), *D. kitiae* Uotila (2013: 75), *D. neglecta* Sukhorukov (2014: 347), *D. nepalensis* (Colla 1836: 25) Mosyakin & Clemants (2008: 428), and *D. tibetica* (Li 1983: 638) Uotila (2013: 67). In the present paper, a new *Dysphania* species from SW China (Xizang, Yunnan provinces) and Bhutan is described on the basis of several unique differences in general morphology and perianth indumentum.

## Material and Methods

The taxonomic revision of the material was undertaken at BM, E, G, MW, K, LE, PE, SHI, W, WUK, XIA, and XJBI [herbarium abbreviations according to Thiers (2008+)]. The perianth and pericarp surfaces were investigated using a scanning electron microscopy (SEM). The material was prepared by dehydration in aqueous ethyl alcohol solutions of increasing concentration, in alcohol-acetone solutions and pure acetone, and then dried at critical-point and sputtercoated with gold-palladium. SEM observations were made with a JSM-6380 (JEOL Ltd., Japan) at 15 kV. The specimens of *D. geoffreyi* marked with asterisk (\*) after herbarium acronym were used for carpological analysis including SEM investigations.

## Results

### *Dysphania geoffreyi* Sukhor. sp. nov.

Holotype<sup>1</sup>:—CHINA. Tibet [Xizang prov.]: Lhasa, Daxika, grassy slope, 4150 m, herb with green flowers, 5 September 1965, *Yong-tian Zhang & Kai-yong Lang 2663* (PE-00510980!)\* (Fig. 1).

**Description:**—Annual, 5–50 cm tall, stem erect, often scarcely branched and then only in the upper part, branches directed upwards; leaves pinnatifid or lobate, appressed to the stem, up to 2 cm long, shortly petiolate (petioles 0.2–0.5 cm), lower leaves caducous at flowering and fruiting times. Inflorescence leafy, lateral branches appressed to the stem or obliquely directed, narrowly cylindrical but never spreading, with axis covered with short simple hairs up to 0.3 mm long mixed with glandular trichomes. Perianth segments 5, cristate on dorsal surface (especially on midrib) with numerous large simple stout hairs up to 0.3 mm, the bases of which can sometimes be conerescent resulting in 2–3-furcate tips, intermixed with yellow subsessile glands and scattered glandular hairs (Fig. 2). Pericarp separates from the seed, with tiny volcano-like papillae. Seed subspherical, 0.5–0.6 mm in diameter; embryo horizontal.

**Etymology:**—The species is named after Dr. Geoffrey Harper (b. 1944), formerly a developmental physiologist at Royal Botanic Garden Edinburgh (UK).

**Habitat:**—Grassy slopes, gravelly substrates, sands and ruderal sites; 2500–4200 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 Not Evaluated (NE) category 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.

**Notes:**—Specimens of *D. geoffreyi* used to be identified as *D. botrys* or *D. nepalensis*. The new species is notable for several characters, such as 1) at least the upper leaves as well as the inflorescence branches being appressed to the stem, 2) very short leaf petioles (up to 0.5 cm), 3) the remarkable indumentum set on the perianth segments, and 4) the smallest seeds among all Eurasian *Dysphania* species. Fruit morphology of *D. geoffreyi* is intermediate between other native *Dysphania* members (see also Table 1). It is possible that the species may also be found in India (Arunachal Pradesh) and North Myanmar.

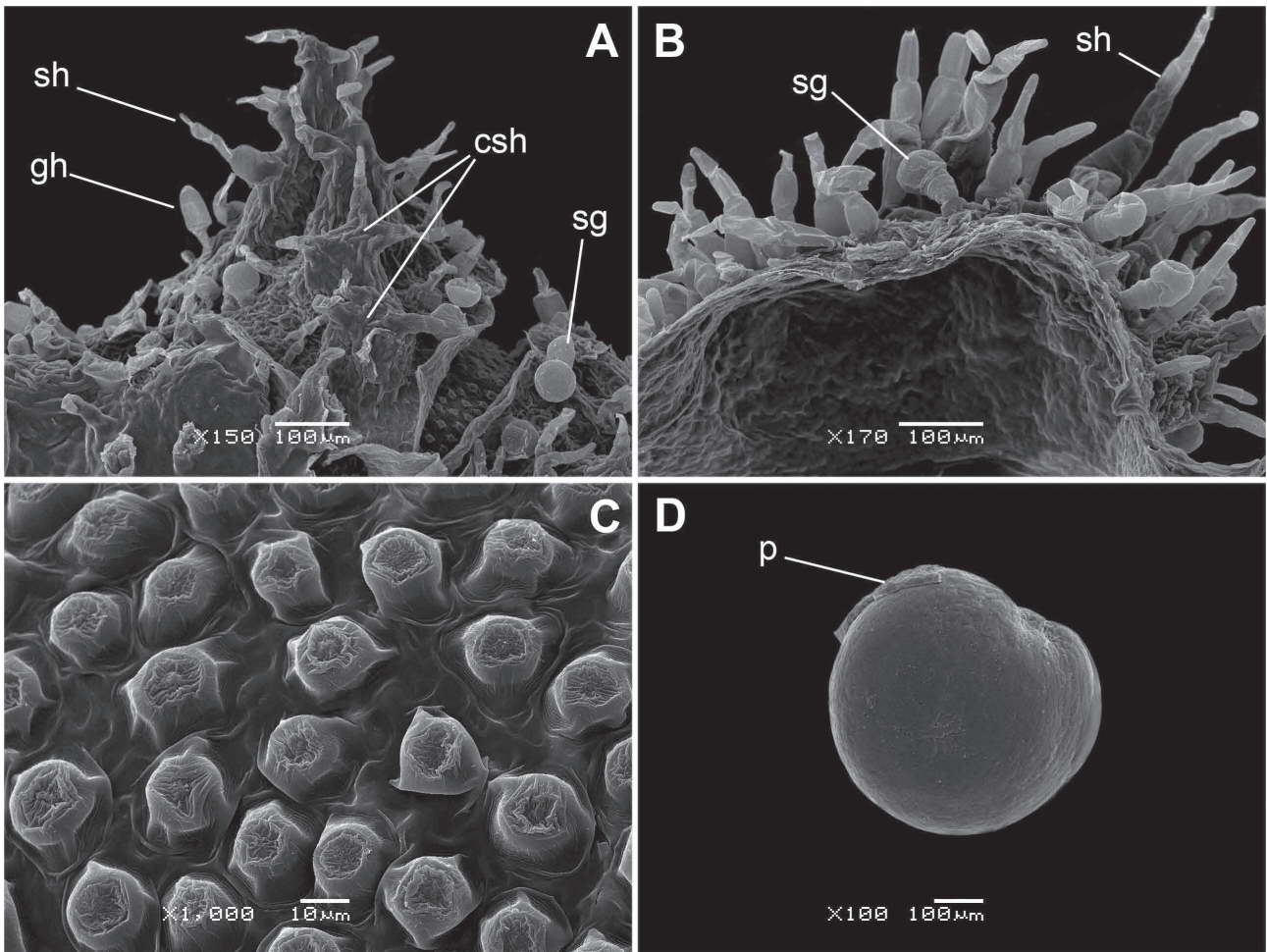
**Specimens examined** (Fig. 3):—BHUTAN. Upper Mo Chu distr. [Punakha distr.]: Gangyvel Chu below Gangyvel, grassy hillside, ca. 3820 m, 27 September 1984, *Sinclair & Long 5364* (E-00151629)\*. CHINA. **Xizang prov.:** Kham (Tibet), basin of Yangtse river, Nru-chu natural feature, gravelly substrate, 25 July 1900, *Ladygin 371* (LE, MW); Vicinity of Lhasa, July 1939, *Richardson 308* (BM); Lhasa, 12000 ft, 5 September 1943, *Ludloff & Sheriff 9919* (BM); Lhasa, 1946–1950, *Aufschnaiter s.n.* (BM); **Yunnan prov.:** Lichiang [26 48'N 100 16'E, near the city Lijiang], in ruderalis, ca. 2500 m, Mid-September 1914, *Schneider 2904* (G)\*; Deqin [Diqing] County, Adunzi, 2700 m, 26 September 1935, *Wang Qiwu 70221* (WUK, original text in Chinese)\*; NE of Zhongdian (Chungtien), Nada village, on top of wall, in turf capping, 3360 m, 27 September 1990, *Chungtien-Lijiang-Dali Expedition 324* (E).

<sup>1</sup> Data on label were translated from Chinese (original text).

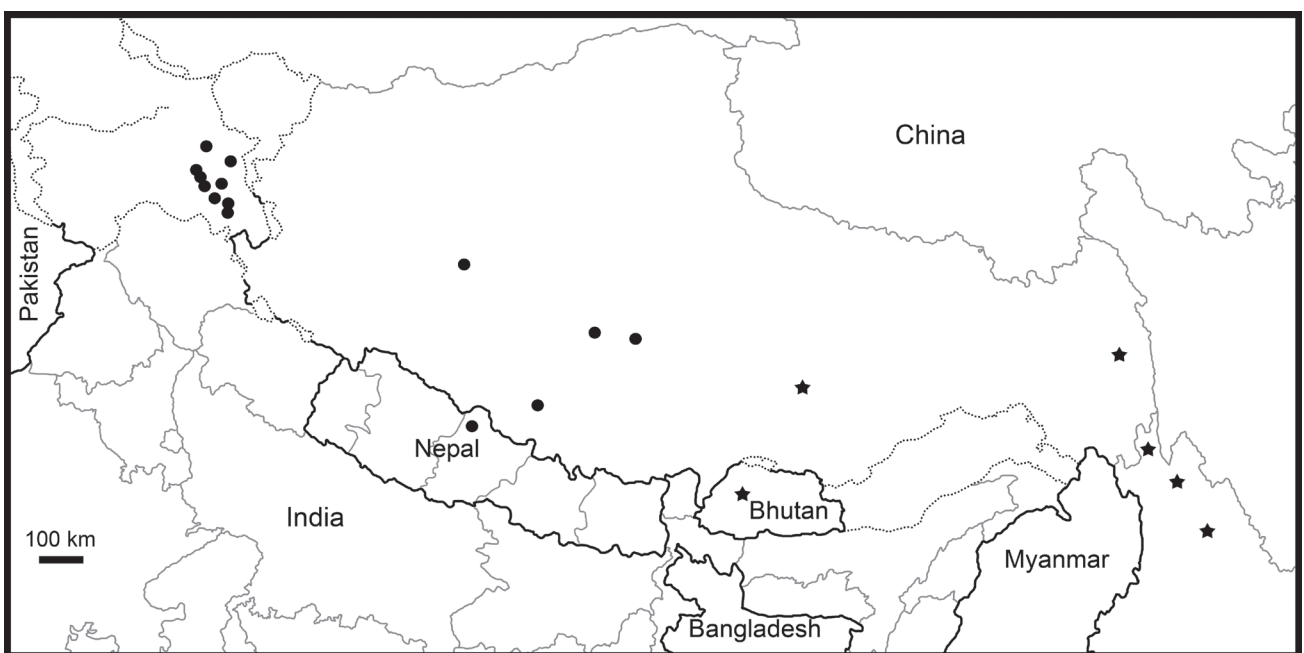


FIGURE 1. Holotype of *Dysphania geoffreyi* (PE-00510980!).





**FIGURE 2.** Perianth, fruit and seed of *D. geoffreyi*. A, B) perianth with stout and long simple hairs (sh), simple hairs with concrecent bases (csh), subsessile glands (sg) and scattered glandular hairs (gh); C) pericarp surface; D) seed with remnants of pericarp (p). Voucher specimens: A, C, D) China, Tibet [Xizang prov.], Lhasa, Daxika, 4150 m, 5 September 1965, *Yong-tian Zhang & Kai-yong Lang* 2663 (PE-00510980!); B) Bhutan, Upper Mo Chu distr. [Punakha distr.], Gangyvel Chu below Gangyvel, ca. 3820 m, 27 September 1984, *Sinclair & Long* 5364 (E-00151629).



**FIGURE 3.** Distribution patterns of *D. geoffreyi* (asterisks) and *D. himalaica* (dots).

**TABLE 1.** Carpological characters of the native Himalayan and Tibetan *Dysphania* species.

The sizes of the subsessile glands on the perianth segments if present are almost the same in all investigated species and vary from 60 to 90  $\mu\text{m}$ . The thickness of the tegmen (inner seed-coat layer) is always minute (1–2  $\mu\text{m}$ ) and is not mentioned in the analysis.

	<b>Inflorescence</b>	<b>Pubescence of the inflorescence axes</b>	<b>Perianth segments (mm)</b>	<b>Indumentum of the dorsal part of perianth segments</b>	<b>Pericarp ultrasculpture</b>	<b>Seed characters</b>
<i>D. bhutanica</i>	spreading, not terminating in aristae	indumentum not dense, consisting of curved simple (to 0.2 mm) and scattered subsessile glands	0.7–0.9 × 0.4	stout simple hairs (up to 80 $\mu\text{m}$ ) and orange (rarely yellow) subsessile glands	minute wart-like papillae (up to 10 $\mu\text{m}$ )	0.6–0.7 mm, subspherical, blackish; testa 8–10 $\mu\text{m}$ thick; embryo horizontal
<i>D. botrys</i>	spreading, not terminating in aristae	indumentum not dense, consisting of curved simple (to 0.3 mm) hairs partially intermixed with glandular hairs	0.7–0.8 × 0.5	glandular hairs (up to 125 $\mu\text{m}$ ) with scaphoid terminal cell and scattered stout simple hairs up to 75 $\mu\text{m}$	terminally concave papillae (10–20 $\mu\text{m}$ )	0.6–0.8 mm, subspherical, blackish; testa 10–12 $\mu\text{m}$ thick; embryo horizontal
<i>D. geoffreyi</i>	clustered, not terminating in aristae	indumentum dense, consisting of curved simple (up to 0.3 mm) and scattered glandular hairs	0.6–0.7 × 0.3–0.4	yellow subsessile glands, numerous stout simple hairs (up to 300 $\mu\text{m}$ ), and scattered glandular hairs (up to 100 $\mu\text{m}$ )	terminally concave papillae (10–20 $\mu\text{m}$ )	0.5–0.6 mm, subspherical, blackish; testa 7–10 $\mu\text{m}$ thick; embryo horizontal
<i>D. himalaica</i>	spreading, not terminating in aristae	indumentum not dense, consisting of semi-appressed or curved simple (up to 0.4 mm) and glandular hairs	0.9–1.1 × 0.2–0.35	stout simple hairs (up to 150 $\mu\text{m}$ ) often red at the segment's tip, and scattered glandular hairs (up to 100 $\mu\text{m}$ )	minute terminally concave papillae (up to 10 $\mu\text{m}$ )	0.7–0.9 × 0.7 × 0.3–0.35 mm, flattened, ovoid, with brown testa 9–12 $\mu\text{m}$ thick; embryo vertical
<i>D. kitiae</i>	spreading, not terminating in aristae	indumentum of scattered short simple hairs (up to 0.3 mm) and glands	1–1.2 × 0.5–0.6	yellow subsessile glands and scattered stout simple hairs (up to 100 $\mu\text{m}$ ), the latter scattered and mostly localized in upper half of the segment	cylindrical papillae (up to 25 $\mu\text{m}$ )	0.7–0.9 mm, subspherical, blackish; testa ca. 12 $\mu\text{m}$ thick; embryo horizontal
<i>D. neglecta</i>	spreading, not terminating in aristae	indumentum dense, consisting of simple (up to 1 mm) hairs partially intermixed with glandular hairs	0.8–1 × 0.5	glandular hairs (up to 125 $\mu\text{m}$ ) having thickened base and scaphoid terminal cell	minute wart-like papillae (up to 10 $\mu\text{m}$ )	0.7–0.8 mm, subspherical, blackish; testa 15–17 $\mu\text{m}$ thick; embryo horizontal
<i>D. nepalensis</i>	spreading, not terminating in aristae	indumentum not dense with simple and glandular hairs	0.7–0.8 × 0.4	yellow subsessile glands and stout simple hairs (up to 100 $\mu\text{m}$ )	cylindrical papillae (up to 30 $\mu\text{m}$ )	0.7–0.8 mm, subspherical, blackish; testa 15–17 $\mu\text{m}$ thick; embryo horizontal
<i>D. tibetica</i>	spike-like, often terminating in short flattened aristae	densely pubescent with semi-appressed or curved simple hairs to 0.6 mm	0.7–0.8 × 0.6	dense, soft simple hairs (up to 300 $\mu\text{m}$ ) and scattered glandular hairs	minute wart-like papillae up to 10 $\mu\text{m}$	1–1.1 × 0.9 × 0.4–0.5 mm, flattened, ovoid, with brownish testa of 4–7 $\mu\text{m}$ ; embryo horizontal

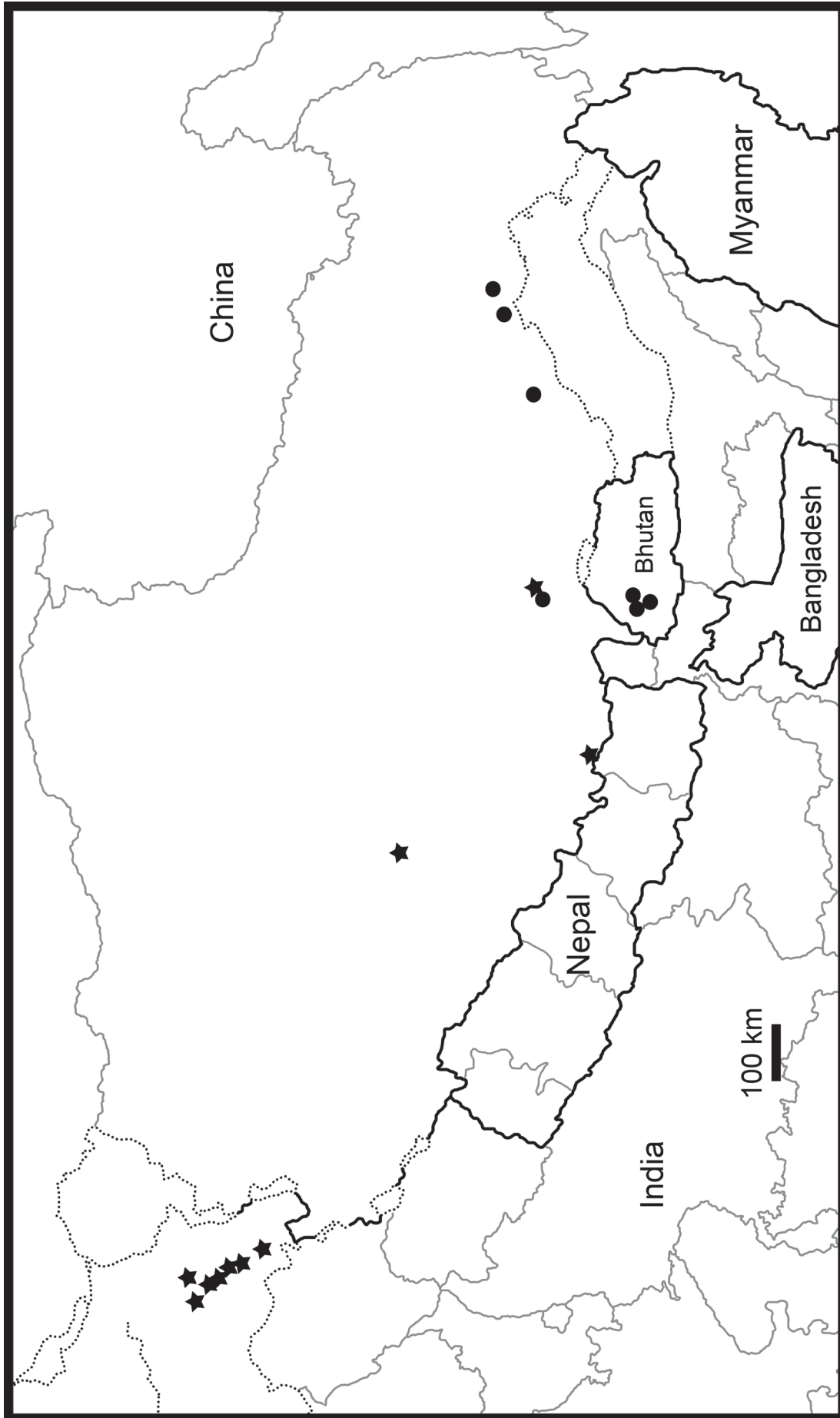


FIGURE 4. Distribution patterns of *D. bhutanica* (dots) and *D. tibetica* (asterisks).

## Discussion

### *Carpological differences between the native Tibetan and Himalayan Dysphania*

In view of the significant increasing of the number of Himalayan and Tibetan species and considering the difficulties in their identification, we provide here an overview and morphometric analysis of the most valuable reproductive features of all native *Dysphania* (Table 1). It supplements previous detailed studies (Sukhorukov 2012a, 2012b, 2014, Sukhorukov & Zhang 2013, Sukhorukov & Kushunina, 2014).

### *Distribution pattern of the native Dysphania in China and adjacent states*

The ranges of some native Asian *Dysphania* taxa (*D. botrys*, *D. nepalensis* and *D. kitiae*) are relatively well known (Uotila 2013, Sukhorukov & Kushunina 2014). Here we combine the previously published records (Sukhorukov 2012a, Uotila 2013) and the new locations of *D. bhutanica*, *D. himalaica* and *D. tibetica* after revision of the specimens in the Chinese herbaria (Figs. 3–4; see also Appendix). It appears that *D. bhutanica* and *D. geoffreyi* are distributed in Eastern Himalaya and SW Tibet, *D. himalaica* occurs in Northern and Central Himalaya and West Tibet (Xizang province of China), while *D. tibetica* has been mostly found within the Himalayan range.

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**Appendix** (the specimens of *D. bhutanica*, *D. himalaica* and *D. tibetica* used for the mapping of the records of these taxa; the specimens preserved at PRA and KAS are cited in Uotila 2013).

*D. bhutanica* (Fig. 4): **BHUTAN**. [Thimphu distr.] Thimphu, 8000 ft, 9 August 1914, *Cooper 3376* (E-00151685); Thimphu, 2408 m, 10 August 1971, *Bedi 657* (K); Thimphu Chu, below Taba, 27°30'N 89°38'E, 2300 m, 22 July 1979, *Grierson & Long 2828* (E-00151632, K); Lango, near Paro, 2300 m, 29 June 1992, *Parker 7263* (E-00051983, holotype); Chapcha, 2200–2400 m, 1 July 1992, *Parker 7270 & 7271* (E-00051982, E-00051981). **CHINA**. Xizang: Gyantse, July–September 1904, *Walton s.n.* (CAL); [Shigatse prefecture, Gyantse county] Tsangpo valley, 10–11000 ft, 5 September 1935, *Kingdon-Ward 12308a* (BM); [Gyantse county] Tsangpo valley, Tse, 9800 ft, 31 May 1938, *Ludlow, Sherriff & Taylor 4585* (BM); [Nyingchi pref.] Mainling co., Pei [Pa] town, 12 September 1974, *The Tibetan collection team 74-4663* (PE-00511047); [Nyingchi pref.] Nang co., 3100 m, 4 August 1982, *Zhi-Cheng et al. 2744* (PE-00511029); [Nyingchi pref.] Mainling co., Qiangna, 22 August 1982, *Zhi-Cheng et al. 3109* (PE-00511027).

*D. himalaica* (Fig. 3): **CHINA**. Xizang: Gérgzé co., Ngari pref., 4250 m, August 1972, *Fa-Chong 69* (PE-00510701); Ali (Ngari), Gérgzé co., 4500 m, 8 September 1976, *Lang Kaiyong 10153* (PE-00511004); Changthang, S shore of Dangra Yum Tso, 30°43'N 86°35'E, 4590 m, 9 September 2003, *G. & S. Miede 03-081-05* (KAS); Changthang, S of Dangra Yum Tso, Targo River S of Targo Shang, 30°35'N, 86°89'E, 4765 m, 10 September 2003, *G. & S. Miede 03-089-01* (KAS); Saga Dzong, Upper Yarlug Tsangpo, 29°21'N, 85°14'E, 28 August 2003, *G. & S. Miede 03-043-23* (KAS). **INDIA**. Jammu & Kashmir: Ladakh: Region Pangong: Lukung, 33°59'5"N, 78°24'6"E, 4300 m, 9 September 2002, code 02-39-10, *Klimesš 6627* (PRA); Region Indus Valley: Zhung (Leh), Chogdo to Chukirmo, 33°49'4"N, 77°38'9"E, 4180–4310 m, 8 September 2001, code 01-41-10, *Klimesš 1627* (PRA); Zhung (Leh), Gya to Lato, 33°40'2"N, 77°43'9"E, 4060–4070 m, 5 September 2001, code 01-38-12, *Klimesš 1539* (PRA); Zhung (Leh), Kiameri La to Rumtse village along the Kyammar Lungpa, 33°35'N, 77°49'E, 4350 m, 15 September 1999, code 99-34-3, *Klimesš 830* (H, PRA); E Stot, Angkhung village to Puga, 33°14'N, 78°16'E, 4550 m, 8 September 1999, code 99-27-9, *Klimesš 6627* (H, PRA); E Stot, Sumdu Gonma to Kiagar La, 33°10'2"N, 78°21'5"E, 4690 m, 7 September 2003, code 03-26-3, *Klimesš 3461* (PRA); Region W & C Shyok, Wari La to confluence of Lurten Lungpa and Lazun Lungpa, 33°10'2"N, 78°21'5"E, 3840 m, 15 September 2001, code 01-47-40, *Klimesš 1868* (PRA); Region Rupshu: Samad Rockhen, Polokongka Valley, 33°16'4"N, 78°6'1"E, 4660–4750 m, 5 August 2002, code 01-8-11, *Klimesš 1255* (PRA); Tso Moriri, Lunglung valley, 33°2'5"N, 78°18'0"E, 4700 m, 8 September 2003, code 03-27-5a, *Klimesš 3476* (PRA); Ladakh, Region Indus valley, E Stot, 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* (PRA, holotype); Samad Rockhen, Thukje village to Nyamur, 33°20'13"N, 78°1'67"E, 4560 m, 9 September 2005, code 05-36-2, *Klimesš 6270* (PRA); Samad Rockhen, Thangmar, 33°20'4"N, 78°1'8"E, 4590 m, 5 August 2001, code 01-8-8, *Klimesš 1271* (PRA). **NEPAL**. Dhaulagiri zone: Mustang distr., Chalungpa, Lower Jeula forest, 28°54'N, 83°45'E, 3410 m, 8 September 2001, *Miede et al. 01-119-03* (KAS).

*D. tibetica* (Fig. 4): **CHINA**. Xizang: [?Xigatse pref.] expedition to Everest, 16000 ft, 1921, *Wollaston 47* (K); Gyangze, 3960 m, 5 September 1974, *Qinghai-Xizang Complex Expedition 74-2077* (PE-00024039, holotype); [Ngari pref.] Coqen, 4000 m, 15 September 1976, *Qingzang Team Zhidi Group 12350* (PE-00540038); Ngari pref., Cuoqin [Coqen] co., Zhari Namco, 4600 m, 15 September 1976, *Tibetan collection team 12580* (PE-00235091). **INDIA**. Jammu and Kashmir: Ladakh: Region Rupshu: Rupshu, 32°58'5"N, 77°24'E, ca. 4600 m, 11 July 2000, code 00-10-4, *Klimesš* (H-1757589); Tso Moriri, Lapgo River Valley, 32°58'7"N, 78°21'3"E, 4810 m, 11 July 2000, *Klimesš*



6268 (PRA); Region Indus Valley: Zhung, Chukirmo, 33°49'5"N, 77°39'1"E, 4150 m, 8 September 2001, *Klimeš 1657* (PRA); Zhung, Lato, 33°40'7"N, 77°43'8"E, 4020 m, 5 September 2001, *Klimeš 1545* (PRA); Zhung, Stagar (Sakti) to Wari La, 34°2'8"N, 77°49'3"E, 4240–4270 m, 12 September 2001, *Klimeš 1741* (PRA); Stot (E), above the Tiri village, 33°31'5"N, 77°58'6"E, 4330–4460 m, 1 August 2001, *Klimeš 1190* (PRA); Region Rupshu: Samand Rockhen, Thukje village to Nyamur, 33°20'13"N, 78°1'67"E, 4560 m, 9 September 2005, *Klimeš 6268* (PRA); Tso Moriri, Karzok to Peldo, 32°59'5"N, 78°15'E, 4550 m, 13 September 2005, *Klimeš 6309* (PRA).