Notes on three new species records of *Euonymus fimbriatus*, *Euonymus fortunei* (Celastraceae) and *Dalbergia hancei* (Fabaceae) in Bhutan

Tsethup TSHERING, Rinzin DORJI¹, Kinzang DENDUP¹, Phub TSHERING¹, Nima Tshering SHERPA¹, Ugyen TAKCHU², Sangay GYELTSHEN², Sangay WANGCHUK and Jigme WANGCHUK*

Ugyen Wangchuck Institute for Forestry Research and Training, Lamai Goenpa, Chhokor, Bumthang 34005, Bhutan
¹Gedu Territorial Forest Division, Department of Forests and Park Services, Chhukha, 21004, Bhutan
²Jigme Khesar Strict Nature Reserve, Department of Forests and Park Services, Haa, 15004, Bhutan

ABSTRACT: This paper aims to add three new species to Bhutan's floral database: *Euonymus fimbriatus* Wall., *Euonymus fortunei* (Turcz.) Hand.-Mazz. from the Celastraceae family, and *Dalbergia hancei* Benth. from the Fabaceae family. We provide descriptions and the spatial distributions of these newly found species.

KEYWORDS: Bhutan, Dalbergia, Euonymus, new records

INTRODUCTION

Extensive floral research, which has resulted in the establishment of Bhutan’s flora, intermittent studies on rare and endemic species, and exploration of medicinal plants have all collectively played pivotal roles in revealing the rich botanical resources nestled within Bhutan’s landscape. Bhutan’s botanical research efforts continue to yield fruitful outcomes, revealing the presence of diverse flora. This has spurred plant enthusiasts, contributing significantly to the growth of floral databases. Consequently, Bhutan’s biodiverse landscape is witnessing a surge in new plant records, including the discovery of new species (Wangchuk et al., 2023) and this novel contribution will continue to grow.

The genus *Euonymus* L. (Celastraceae) comprises over 200 species worldwide. *Euonymus* includes trees, shrubs, and vines that trail along stems or climb with the help of other structures, such as trees or walls, exhibiting a wide array of habits. This genus is extensively used for ornamental purposes in landscape gardening due to its inherent qualities of being evergreen, frost-resistant, and capable of withstanding extreme cold conditions (Savinov and Trusov, 2018). In Bhutan, 12 species have been documented: *E. attenuatus* Wall. ex M. A. Lawson; *E. lucidus* D. Don., *E. tingens* Wall., *E. grandiflorus* Wall., *E. theifolius* Wall. ex M. A. Lawson; *E. echinatus* Wall., *E. vagans* Wall., *E. viburnoides* Prain, *E. lawsonii* C. B. Clarke ex Prain, *E. frigidus* Wall., *E. porphyreus* Loes., and *E. amygdalifolius* Franch. (Grierson and Long, 1987). However, it is noted that *E. porphyreus* Loes. and *E. amygdalifolius* Franch. are synonyms of *E. frigidus*, reducing the count to 10 species. The expected presence of *E. fimbriatus* Wall. in Bhutan was not confirmed; instead, the closest known occurrence of this species to Bhutan was reported in Sikkim by Grierson and Long in 1991. Similarly, *E. hamiltonianus* Wall., *E. macrocarpus* Gamble ex Oliv., and *E. amygdalifolius* Franch. (Grierson and Long, 1987). However, it is noted that *E. porphyreus* Loes. and *E. amygdalifolius* Franch. are synonyms of *E. frigidus*, reducing the count to 10 species. The expected presence of *E. fimbriatus* Wall. in Bhutan was not confirmed; instead, the closest known occurrence of this species to Bhutan was reported in Sikkim by Grierson and Long in 1991. Similarly, *E. hamiltonianus* Wall., *E. macrocarpus* Gamble ex Oliv., and *E. tibeticus* W. W. Smith have been reported in neighboring regions with a temperate climate concurrent to Bhutan, such as Arunachal Pradesh, Tibet, and Darjeeling, respectively (Grierson and Long, 1991). While these species and many others are likely present in Bhutan, their occurrence needs confirmation through additional field surveys. *Euonymus fortunei* is widely distributed through avenue plantation and landscape management across Asia, America, Australia, and Europe. However, its natural presence in Bhutan has remained...
unestablished. A comprehensive exploration is essential to ascertain the extent of the distribution range of this species. The genus *Dalbergia* L.f comprises nearly 250 species in the tropics (Klitgaard and Lavin, 2005; Mabberley, 2008; Li et al., 2017), and displays various life forms, such as climbers, shrubs, trees, and woody lianas (Saha et al., 2013; Rahaingoson et al., 2022). The leaves are usually compound, arranged alternately, and imparipinnate with alternate leaflets, rarely sub-opposite and glabrous (Saha et al., 2013). The flowers are 2–20 mm in size, usually appearing white, light yellow, or purple with a light green spot at the center of the vexillum. The fruits are oblong pods, ligulate, winged, and elliptic in shape (Carvalho, 1997; Shu, 2010). These plants hold economic significance, providing not only high-quality timber, widely known as rosewood, utilized in construction, furniture, and musical instruments (Lewis et al., 2005) but also playing a vital role in traditional medicine and phytochemical studies (Saha et al., 2013). Asia has the highest distribution (ca. 119 species) followed by Africa (ca. 116 species) and Central and South America (ca. 80 species) (Vatanparast et al., 2013). Bhutan has six species belonging to this genus: *D. sissoo* Roxb. ex DC., *D. rimosa* Roxb., *D. stipulacea* Roxb., *D. pinnata* (Lour.) Prain, *D. millettii* var. *mimosoides* (French) Thoth. (synonym: *D. mimosoides* Franch.), and *D. sericea* G. Don. (Grierson and Long, 1987). *D. assamica* Benth., which was found in Kalimpong, while *D. latifolia* Roxb. and *D. volubilis* Roxb. located in Sikkim Terai, suggests a probable presence in Bhutan's range (Grierson and Long, 1987).

During the nature guiding tour in Jigme Khesar Strict Nature Reserve, *E. fimbriatus* was revealed as one of the uncovered species in Flora of Bhutan. Similarly, *E. fortunei* and *D. hancei* were encountered during rapid biodiversity survey at Gedu and Shakhu under Gedu Forest Division. This paper focusses on three species previously unrecorded, expanding their distributional range in Bhutan. We provide morphological descriptions, distributions, and photographs of these newly found species.

### MATERIALS AND METHODS

The outcomes of two floristic surveys, conducted as part of a rapid biodiversity assessment in May 2023 within the Jigme Khesar Strict Nature Reserve and the Gedu Territorial Forest Division, led to the discovery of three species (Fig. 1). The morphological characteristics and its related taxa were observed using photographs and collected specimens. The collected plants were examined and identified using the Flora of Bhutan (Grierson and Long, 1987, 1991), Royal Botanic...
Gardens, Kew (2023), Global Biodiversity Information Facility (2023), Flora of China (2023), eFlora of India (2024), and related articles (Schulz, 2006; Chen et al., 2010). Photographic evidences are presented for the phenophases observed during the survey. The specimens were dry-mounted with field data labels and deposited in the National Herbarium (THIM) at the National Biodiversity Centre, Serbithang, Thimphu for reference and a copy of every specimen was maintained at Ugyen Wangchuck Institute for Forestry Research and Training for educational purposes and research.

TAXONOMIC TREATMENT

1. Euonymus fimbriatus Wall., Fl. Ind. 2: 408, 1824 (Fig. 2A, B).—TYPE: INDIA. Kumaon, 1824, N. Wallich 4287 (K000669601).


Deciduous shrub or tree up to 15 m tall; bark dark gray. Leaves opposite; petiole 5–10 mm long; leaf blade leathery, elliptic-ovate 6.5–10 × 3–6 cm long, base cuneate, margin finely serrated, apex acuminate; lateral veins 5–7 pairs, disappearing before reaching margin. Red peduncle present on new branches only, slender 2–4 cm long, 3–4 branched with several flowers; pedicel short and slender, ca. 6 mm long. Flowers many, umbel-like cymes with flower-cluster stalks 2.5–7.6 cm long, 4–5-merous; petals greenish-yellow, 1–2.5 mm long, oblong-ovate, entire. Fruits capsule ligulate, winged with ridges along its length, reddish or purplish-brown when mature.

Flowering: April–May.

Taxonomic notes: Euonymus fimbriatus has a higher degree of resemblance to Euonymus lacerus Buch.-Ham., in terms of leaf arrangement, climbing habits, and arrangement of flowers and fruits. However, E. lacerus tends to have slightly larger leaves and marginally larger flowers. E. fimbriatus is popular in gardens and landscapes for its attractive foliage and colorful autumn display. E. fimbriatus thrives in temperate climate characterized by moderate humidity, and annual rainfall. It exhibits a presence of well-drained soil and is commonly observed growing loamy, and sandy soil types. They are typically found at the woodland edges, stream and river banks, as well as disturbed areas such as roadsides and abandoned fields.

Distribution: Afghanistan, India (Kashmir, Sikkim), Nepal, Pakistan, China, Japan, Korea, Bhutan.

Specimen examined: BHUTAN. Haa District, Gentsha along the river Haachhu, below the Gentsha suspension bridge (600 m), about 20 m upstream of Yangthang motorable bridge connecting Chundupang School and Haa town, usually grown in open areas of Blue pine forest in the temperate biome, 27°40’902.67N, 89°24’973.9E, elev. 2,735 m, 2 May 2023, Shering, Gyeltshen, Takchu, TT010 (UWIFoRT).

It is also found above the town after crossing a motorable bridge connecting Haa town and Damthang, as well as downstream of Haa town, above Helipad, along the bank of the river. They are usually found growing isolated at a distance of ca. 10–20 m from one another.


Euonymus patens Rehder., Trees & Shrubs (Sargent) 1: 127, Pl. 64, 1903.


Evergreen woody shrubs, procumbent on the ground, ascending on rocks or trees using aerial roots. Stems stout, green, and hairless when young becoming grey, slightly warty or corky, and hairy with age, but may turn greenish-purple during severe cold. Petiole 2–9 mm, sometimes sessile. Leaves dark green, green-white, or green-gold variegation with some red, fleshy-coated (Miller et al., 2010).

Flowering: May to July

Fruiting: September-November

Taxonomic notes: Euonymus fortunei, commonly known as wintercreeper, is not only the most widespread but also the most complex and polymorphic species. It can often be confused with E. japonicus Thunb., E. theifolius Wall. ex M.A. Lawson., and E. vagans Wall. Euonymus fortunei exhibits an invasive nature capable of potential reproduction through
apomixis or clonal propagation via propagule fragments (Elam and Culley, 2023). However, the extent of its population and spread within the country remain unknown. *E. fortunei* is found in cool-broadleaf to temperate forests adaptable to different climates and soil types. They are common in woodland, scrub, and forest edges in disturbed or open areas, sometimes providing ground cover that controls erosion. It is widely creeping on the ground and trees, almost all the trees and shrubs. It is likely a heavy colonizer, but host trees and shrubs are not found dead.

**Distribution:** China, India, Indonesia, Japan, Korea, Laos, Myanmar, Pakistan, Philippines, Thailand, Vietnam, United States of America (Introduced), Africa (Introduced), Canada, Australia, New Zealand, Germany, Poland, Austria, Netherlands, Belgium, Sweden, Belarus, Denmark, Switzerland, Denmark, Portugal, France, South Korea, United Kingdom, Bhutan.

**Specimen examined:** BHUTAN. Chhukha District, in the cool-broadleaf forest, above the national highway, near Gedu Range Office with associate plants *Litsea elongata* (Nees) Benth. & Hook.fil. [illegimate] and *Symlocos ramosissima* Wall, 26.91641082N, 89.52589575E, elev. 1,990 m, 2 May 2023, Tshering, Dorji, Dendhup, P. Tshering, Sherpa TT011 (UWIFoRT).

It is also found in Darla, Arekha, and Taktikothi (Chapcha) grown along the highway. As of now, unlike elsewhere in the region, it has not been used as an avenue plantation in Bhutan.

**Key to the species of Euonymus in Bhutan**

1. Evergreen; flowers mostly 5-merous; capsules 5-valved and subtended by 5 persistent calyx lobes. ………………………………………………………………………………………….. *E. attenuatus*

2. Leaves entire or with a few teeth near apex; anther subsessile ……………………………………………………………………………………..

2. Leaves with prominent teeth extending almost to the base; anthers attached on distinct filaments 4–10 × 1.5–6 mm.

3. Leaves smooth above, marginal teeth with sharp subulate points; cymes 7–15 flowered; petals ca. 3.5 mm …………… *E. lucidus*

3. Leaves rugose and reticulate above, leaf margin shallow, bluntly to sharply serrate but without subulate points; cymes mostly 3-flowered; petals ca. 5 mm.

4. Small tree; leaves ovate-elliptic, 3–6 cm; capsules ca. 1.5 cm diameter up to 2 cm after dehiscence … *E. tingens*

4. Climbing shrub; leaves elliptic-lanceolate 6–9 cm; capsule ca. 2 cm diameter up to 4 cm after dehiscence ……………………

………………………………………………………………………………………………………………………………………………………….. *E. macrocarpus*
1. Evergreen or deciduous; flowers 4-merous; capsules 4-valved and subtended by 4 persistent calyx lobes.

5. Petals 4-8 mm; filament 2–2.5 mm.

6. Evergreen shrub; inconspicuous flowers; capsule fruits containing seeds; leaf margin crenulate or serrate; branchlets ribbed; cymes 3–8 flowered.

7. Leaves 6–10 × 1.5–3.5 cm, ovate-elliptic-lanceolate, base rounded or cuneate, margin serrate; branchlets 4-ribbed ................................................................. *E. theifolius*

7. Leaves 2.5 × 2–3.5 cm, ovate-elliptic, base nearly truncate, at times cuneate, margin crenulate to serrate, apex obtuse to acute; base nearly truncate; branchlet 4-ribbed ................................................................. *E. fortunei*

5. Deciduous shrub; inconspicuous flower; capsule fruits containing seeds; leaf margin serrulate to almost entire, branchlets not ribbed; cymes 3 (– 6)-flowered ................................................................. *E. grandiflorus*

5. Petals 2–3 mm; filament absent or up to 1.2 mm.

8. Petals white, creamy or greenish; anthers on filaments, 0.5–1.2 mm.

9. Lateral veins of leaves widely spreading and arching with 6–8 pairs; petals white, greenish or yellowish, sub-orbicular 2.5–3 mm; ovary warty ................................................................. *E. echinatus*

9. Lateral veins of leaves ascending but disappears before reaching margin with 5–7 pairs; petals whitish, yellowish, or greenish; ovary smooth or slightly textured.

10. Petals nearly orbicular, greenish or whitish; lateral veins ca. 5 pairs, usually impressed adaxially; ovary smooth ................................................................. *E. vagans*

10. Petals yellow or greenish yellow; lateral veins of the leaves 5–7 pairs; ovary slightly textured ........................ *E. fimбриatus*

8. Petals crimson, anthers subsessile on disc.

11. Anther 2-celled (with median constriction); winter buds small, 2–3 mm, evergreen but leaves not coriaceous

12. Small epiphytic shrub, often pendulous or climber; leaf base rounded or broadly cuneate, margin serrulate ................................................................. *E. viburnoides*

12. Small erect tree or shrub; not pendulous, leaf base attenuate, margin coarsely serrate ........................ *E. lawsonii*

11. Anther 1-celled (without median constriction); winter buds large 5–10 mm; evergreen, leave coriaceous ........................ *E. frigidus*


Climbing shrub, glabrous, branches terete, grows primarily in the wet tropical biome. The main stem six meters in height and branches a liana (woody vine) naturally climbing onto other trees nearby. Leaves oblong, alternate, imparipinnate, shortly petiolate (3 mm), glabrous on both surfaces, 7–13 pairs leaves leathery with alternate venation.

*Dalbergia hancei* shares similar habits with *Dalbergia odorifera* T. C. Chen, including climbing habits and possesses fragrant rosewood. However, they typically differ; *D. hancei* has 7–13 leaflets, and young pale-pink flower turns to a large white flower arranged in panicles when matured, while *D. odorifera* has 9–19 leaflets, and has small yellow flowers in racemes.

**Taxonomic notes:** *Dalbergia hancei* is typically observed in tropical and subtropical regions with warm climates and moderate to high humidity levels. They are grown in well-drained soil enriched with organic matter and also grow in sandy loam, clay loam, and lateritic soils. This species often grows under the canopy of larger trees, exhibiting liana habits with long-stemmed woody vines that is rooted in soil. It uses other means of vertical support, such as trees or rocks, to climb and spread.

**Distribution:** The native range of this species is South-East Asia, China (Hong Kong, Hainan), Thailand, Vietnam, Laos, India, Bhutan.

**Specimens examined:** BHUTAN. Chukka District, Shaku (Khamphula), above farm road connecting Shakhu before reaching the village. Grown in wet areas with associated plants *Aporosa octandra* (Buch.-Ham.ex D.Deon), *Casearia glomerata* Roxb., *Schima wallichii* (DC.) Korth., *Maesa indica* (Roxb.) A. DC. and *Wrightia sikkimensis* Gamble, 26.731851N, 89.71550337E, elev. 496 m, 8 Mar 2023, *Tshering Dorji*, *Dhendup*, *Phub Tshering*, *Sherpa*, TT009 (UWIFoRT); Sarpang District, Singye, Yarpheling near Phispoo Wildlife Sanctuary Headquarters, 26.84766342N, 90.20831611E, elev. 322 m, 23 May 2024.

**Key to the species of Dalbergia in Bhutan**

1. Leaves compound, alternate, pinnate with (3–)4–6 ovate to oblong leaflets ................................. *Dalbergia sissoo*
1. Leaves compound, alternate, leaflets more than 4-6.
2. Sprawling tree or scandent shrub with 17–21 leaflets with pointed apex; distinct stipules at the base of each leaflet.  
   \[\textbf{D. stipulacea}\]
3. Trees without distinct stipules or with different leaflet characteristics.
4. Trees 10–25 m, without distinct stipules, leaves pinnate along the midvein with 25-41 leaflets.  
   \[\textbf{D. pinnata}\]
5. Shrubs or small trees; stipule caducous but not persistent, leaves pinnate, leaflets less than 25-35.
6. Shrub with 23–35 leaflets, rounded or notched apex.  
   \[\textbf{D. millettii var. minmosoides}\]
7. Shrubs or small trees with leaflets less than 25-35 and serrated margins.
8. Shrub or small tree 2–5 m; leaflets (3–)5–7(–9); leaves with finely serrated margin.  
   \[\textbf{D. rimosa}\]
9. Trees with different leaflet numbers and smooth margins.
10. Tree 15–20 m; crown broad and spreading; leaves alternate, 15-25 cm imparipinnate, leaflets (9–)13–19(–21), leaves with smooth margin; ovary shortly stipitate.  
   \[\textbf{D. sericea}\]
11. Tree 10–20 m; crown spreading with a liana form; leaves 5-8 cm, alternate, lanceolate or oblong with a pointed tip, leaflets 7–13; leaves with smooth margins; ovary shortly stipitate.  
   \[\textbf{D. hancei}\]

**ACKNOWLEDGMENTS**

We would like to extend our deep gratitude to the management of Ugyen Wangchuck Institute for Forestry Research and Training, Gedu Territorial Forest Division, Jigme Khesar Strict Nature Reserve, and the Department of Forests and Park Services for guidance and support for this work.

**CONFLICTS OF INTEREST**

The authors declare that there are no conflicts of interest.

**LITERATURE CITED**

Miller, J. H., E. B. Chambliss and N. J. Loewenstein. 2010. A


