



A taxonomic revision of the genus *Cephalotaxus* (Taxaceae)

XUE-DONG LANG^{1,2}, JIAN-RONG SU^{2*}, SHU-GANG LU^{1*} & ZHI-JUN ZHANG²

¹School of Life Sciences, Yunnan University, Kunming, 650091, China

²Research Institute of Resources Insects, Chinese Academy of Forestry, Kunming, 650224, China

* Authors for correspondence, email: Jian-Rong Su, jianrongsu@vip.sina.com; Shu-Gang Lu, shuganglu@163.com

Abstract

A taxonomic revision of the genus *Cephalotaxus* is presented based on taxonomic literature, herbarium specimens and field work. We conclude the genus to contain seven species: *C. oliveri*, *C. fortunei*, *C. griffithii*, *C. alpina*, *C. harringtonii*, *C. nana* and *C. hainanensis*. We accept *C. hainanensis* and *C. griffithii* as separate species and not as synonyms of *C. mannii*, because type specimens of these taxa are not identical in the shape and size of the leaves. A key to all species, distribution maps and photographs of *Cephalotaxus* are also provided.

Introduction

The ‘plum yews’, *Cephalotaxus* Sieb. & Zucc. ex Endlicher (1842: 27), form a small genus of conifers that occurs in eastern Asia, north of the Indo-Chinese peninsula (Fu 1984, Lang *et al.* 2011a). The taxonomic history of *Cephalotaxus* was described in detail in an earlier paper by Lang *et al.* (2011a). The genus was originally included in Taxaceae by Pilger (1903), but Neger (1907) separated it into its own the family, Cephalotaxaceae. *Cephalotaxus* was generally considered to be the only genus within the Cephalotaxaceae, although some authors (e.g., Pilger 1926, Phillips 1941, Page in Kubitzki 1990) also included *Amentotaxus* Pilger (1916a: 41) in this family. However, recently, in the latest classification system of gymnosperms, Christenhusz *et al.* (2011) placed *Cephalotaxus* back into the Taxaceae where it appears taxonomically between *Taxus* and *Amentotaxus* (Table 1). In this paper, we have follow the circumscription of Christenhusz *et al.* and place *Cephalotaxus* in the Taxaceae to prevent the unnecessary usage of two small segregate monogeneric families.

TABLE 1. A taxonomic status of *Cephalotaxus* in the gymnosperm classification system after Christenhusz *et al.* (2011).

12. Taxaceae (contains Cephalotaxaceae, Amentotaxaceae, Austrotaxaceae and Torreyaaceae)
12.1. <i>Austrotaxus</i> Compton (1922: 427)
12.2. <i>Pseudotaxus</i> W. C. Cheng (1948: 1)
12.3. <i>Taxus</i> L. (1753: 1040)
12.4. <i>Cephalotaxus</i> Sieb. & Zucc. ex Endl. (1842: 27)
12.5. <i>Amentotaxus</i> Pilger (1916a: 41)
12.6. <i>Torreya</i> Arnott (1838: 130)

Since Endlicher (1842) published the name *Cephalotaxus*, over 70 names have been published in the genus (Appendix 1). However, there is still no general agreement on taxonomy, nor is there any monograph on *Cephalotaxus* available describing how many species should be accepted. Some controversial problems still exist in almost all taxa with the exception of the well-defined *C. oliveri*—this confusion has occurred because the key taxonomic characteristics of most species, such as stomatal band whiteness, length and shape of needles, bark colour, etc., generally intergrade morphologically. It is thus difficult to know how to identify individual plants, with differences of opinion coming from decisions of taxonomists in different countries

(Lang *et al.* 2011a). Generally, taxonomists from Japan and South Korea accept *C. harringtonii* (Knight ex Forbes 1839: 217) Koch (1873: 102), *C. harringtonii* var. *nana* (Nakai 1919: 193) Rehder (1941: 569) and *C. koreana* Nakai (1930: 508) for Japan and South Korea (Ohwi 1965, KPNC 2011). *Cephalotaxus wilsoniana* Hayata (1914: 22) is endemic to Taiwan (Li & Keng 1994). Chinese mainland taxonomists such as Fu *et al.* (1999a) argued that *C. mannii* Hooker (1886: 16), *C. griffithii* Hooker (1888: 648) and *C. hainanensis* Li (1953: 164) should be synonymized and they considered *C. fortunei* Hooker (1850: 76) var. *concolor* Franchet (1899: 265) to be a synonym of *C. fortunei*; they also accept *C. fortunei*, *C. fortunei* var. *alpina* Li (1953: 164), *C. lanceolata* K.M.Feng in Cheng *et al.* (1975: 86), *C. sinensis* (Rehder & Wilson 1914: 3) Li (1953: 162), *C. latifolia* W.C.Cheng & L.K.Fu ex Fu & Mill (1999b: 185), *C. mannii* and *C. oliveri* to occur in China. *Cephalotaxus mannii* and *C. griffithii* were also considered to occur in India, Burma, Laos, Thailand and Vietnam (Fu 1984, Hiệp & Vidal 1996, Newman 2007, Thomas *et al.* 2007, Werner 1997, Phengklai 1972). Additionally, Silba (2007) published two subspecies known from Japan and Thailand, *C. harringtonii* subsp. *hokkaidoensis* Silba (2007: 9) and *C. mannii* subsp. *thailandensis* (Silba 2000: 22) Silba (2007: 13). Two other taxa, *C. harringtonii* var. *sphaeralis* (Masters 1884: 113, 1887: 203) Rehder (1914: 716) and *C. sinensis* f. *globosa* (Rehder & Wilson 1914: 3) Li (1953: 163) have rarely been cited by any taxonomists since their names were published. This introduction shows *Cephalotaxus* taxonomy remains particularly problematic, which we intend to address here.

Cephalotaxus species are not only used as garden plants for their beauty, but have traditionally been used as for building or wood carving material (Lang *et al.* 2011b). Nowadays, *Cephalotaxus* is more important for medicinal purposes, because they contain alkaloids such as cephalotaxine esters and terpenoids, compounds that are only found in members of this genus. The anticarcinogenic potential is especially used in the treatment of leukaemia (Chu 1979, Abdelkafi 2012). Therefore, a good taxonomy is needed to know which species yield the best chemical compounds. A good taxonomy is the foundation that underpins all other botanical research and the correct names of plant material used in botanical studies is not known, these studies become useless. In a taxonomically difficult genus like *Cephalotaxus*, it is vital that the taxonomy is robust and will stand the test of time and will be reliable when using characters that are well-defined and easy to apply when identifying material. We have hereby tried our best to produce such a taxonomic treatment, based on taxonomic literature, herbarium specimens and field work.

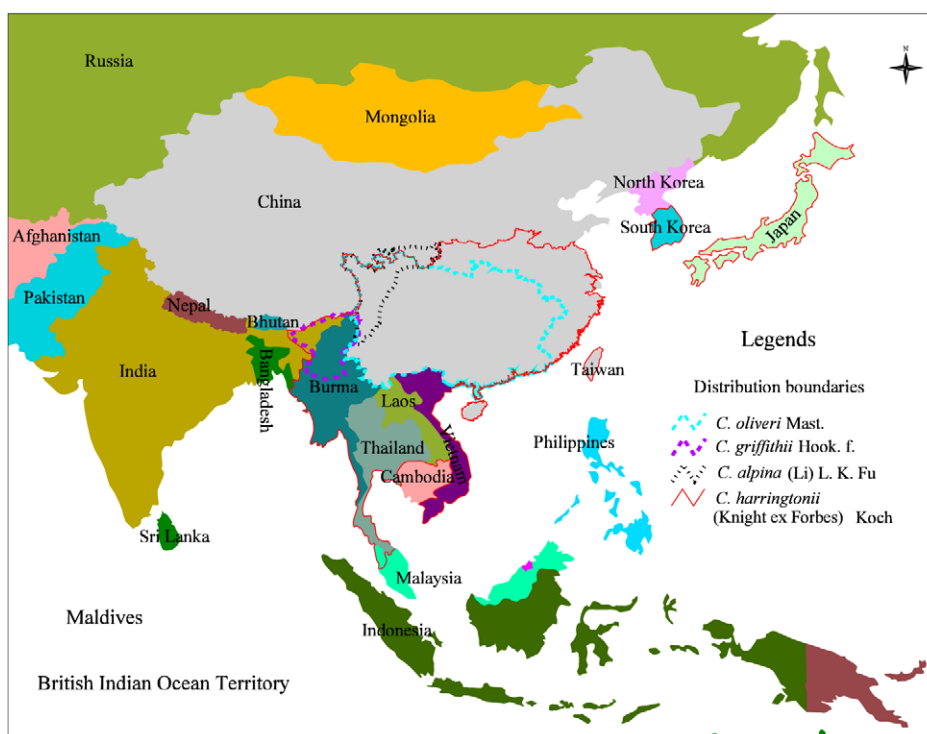


FIGURE 1. The distribution of *Cephalotaxus* species-I.

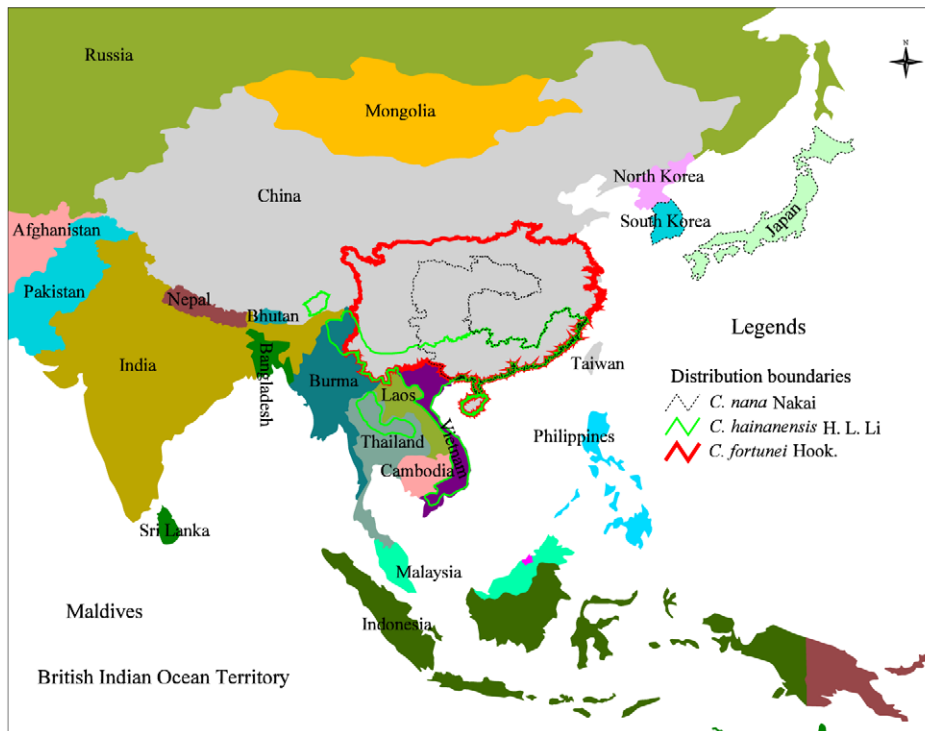


FIGURE 2. The distribution of *Cephalotaxus* species-II.

Taxonomic treatment

Cephalotaxus Sieb. & Zucc. ex Endlicher (1842: 27).

Lectotype (designated by Rehder 1949): *Cephalotaxus pedunculata* Sieb. & Zucc. ex Endlicher (1847: 238).
nom. illeg. [= *C. harringtonii* (Knight ex Forbes 1839: 217) Koch (1873: 102)]

Evergreen trees or shrubs; dioecious or monoecious; bud scales persistent. Leaves 2-ranked, pectinately arranged; blade linear, linear-lanceolate, or occasionally lanceolate, midvein green abaxially, elevated on both surfaces; stomatal bands 2, abaxial, each comprising 11–24 rows of stomata, usually appearing white, as wide as or usually wider than midvein; marginal bands green, as wide as or narrower than midvein; resin canal abaxial. Pollen cones borne on branches of preceding year, aggregated into capitula of 6–8; capitula axillary, solitary, pedunculate or sessile, peduncle usually with several spirally arranged scales, rarely naked; cones subtended by 1 ovate or triangular-ovate bract; microsporophylls 4–16, each with 2–4 pollen sacs, pollen nonsaccate. Seed cones borne in axils of terminal bud scales, long pedunculate, floral axis with several pairs of decussate bracts each bearing 2 erect, axillary ovules. Seeds ripening in second year, drupe-like, completely enclosed by succulent aril, ovoid, ellipsoid, or globose, apex mucronate. Cotyledons 2; germination epigeal or hypogeal.

Taxonomic notes:—Lang *et al.* (2011a, b) ascripted *Cephalotaxus* to Siebold & Zuccarini’s 1870 work, thinking that the name of *Cephalotaxus* should be cited as “*Cephalotaxus* Siebold & Zucc.—Fl. Jap. II. 66. 1870” rather than “*Cephalotaxus* Siebold & Zucc. ex Endl.—Gen. Pl. Suppl. 2: 27. 1842”. However, this is an erroneous conclusion, because Recommendation 34A.1 of the Vienna Code (2006) is not mandatory unlike Articles. Moreover, there was no Code in force in 1842 so Endlicher could not have followed this Recommendation. At the time, it was common practice for authors to take up unpublished names from other works. So, in this paper, this wrong conclusion reached in Lang *et al.* (2011a, b) is fully retracted and revert to using the 1842 publication as being the first effective and valid publication of the name *Cephalotaxus*. Further more, the taxonomic treatment in Lang *et al.* is markedly different to the most recent treatment of the genus by Farjon (2010), these differences are tabulated in the following Table 2.

TABLE 2. The taxonomic differences of the genus between Lang *et al.* (here) and Farjon

Accepted by Farjon (2010)	Accepted by Lang <i>et al.</i>	Comments
8 species	7 species	
<i>C. oliveri</i>	√	
<i>C. hainanensis</i>	√	
<i>C. harringtonii</i>	√	
<i>C. fortunei</i>	√	
<i>C. fortunei</i> var. <i>fortunei</i>	×	
×	<i>C. griffithii</i>	Farjon: as a synonym of <i>C. mannii</i>
<i>C. harringtonii</i> var. <i>nana</i>	<i>C. nana</i>	
<i>C. fortunei</i> var. <i>alpina</i>	<i>C. alpina</i>	
<i>C. harringtonii</i> var. <i>wilsoniana</i>	×	Lang <i>et al.</i> : as a synonym of <i>C. harringtonii</i>
<i>C. lanceolata</i>	×	Lang <i>et al.</i> : as a synonym of <i>C. griffithii</i>
<i>C. latifolia</i>	×	Lang <i>et al.</i> : as a synonym of <i>C. nana</i>
<i>C. mannii</i>	×	Lang <i>et al.</i> : as a synonym of <i>C. harringtonii</i>
<i>C. sinensis</i>	×	Lang <i>et al.</i> : as a synonym of <i>C. harringtonii</i>

Also, *C. drupacea* var. *sinensis* f. *globosa* was regarded as a synonym of *C. fortunei* by Farjon, and Lang *et al.* regarded it as a synonym of *C. nana*.

Key to the species of *Cephalotaxus*

1. Leaf bases cordate-truncate, margins touching each other; mature fruits with aril separate from testa, and cotyledon germination hypogeal..... *C. oliveri*
- Leaf base truncate, obtuse, cuneate, or shortly attenuate, margins not touching; aril not separate from testa, and cotyledon germination epigeal..... 2
2. Leaves 4–16 cm long, often more than 8 cm..... 3
- Leaves 1.5–8 cm long, usually less than 5 cm..... 5
3. Leaves lanceolate, base most widely, rounded, 4–10 cm long, 4.5–5.0 mm wide; seeds obovate-elliptic, long 3.5–4.5 cm..... *C. griffithii*
4. Leaves linear or linear-lanceolate, base cuneate or broadly cuneate, 4–13(–16) cm long, 2.0–3.5(–7.5) mm wide; seeds elliptic, long 1.2–3.0 cm..... 4
- Leaves 4–16 cm long, 3.5–7.5 mm wide, usually pendulous or horizontal; seeds 1.4–2.8 cm long, 0.9–1.5 cm wide, 0.6–1.0 cm thick, width to thickness ratio 1.26–1.97; male cones 6–8 mm long *C. fortunei*
- Leaves 4–13 cm long, wide 2.0–3.5 mm; seeds 1.2–2.3 cm long, wide 0.7–1.2 cm, thick 0.7–1.0 cm, width to thickness ratio 1.02–1.25; male flowers sessile or only 1–2 mm long *C. alpina*
5. Shrubs, often 1–3 m high; leaves straight or very slightly curved, apex often convex acuminate or acute, base rounded, 2.5–3.5 cm long, 3.5–6.0 mm wide, edges rolling downwards when dry; male inflorescences ca. 6 mm in diameter..... *C. globosa*
- Tall trees, often 4–20 m high; leaves straight to slightly curved or sickle shaped, apex acuminate or slightly acute, base cuneate or truncate, 2.0–4.5(–8.0) cm long, ca. 3.0–4.5 mm wide, edges rolling downwards when dry or not; male cones ca. 3–4(–7) mm in diameter 6
6. Leaves usually straight or slightly curved; 2–5(–8) cm long, ca. 3 mm wide, base cuneate, broadly cuneate or sometimes nearly rounded, usually apex acuminate or slightly acute; male cones ca. 3 mm; seeds ovoid, elliptic-ovate or subglobose, long 1.8–2.5 cm..... *C. harringtonii*
- Leaves sickle-shaped or straight, 2.0–4.5 cm long, 3.5–4.5 mm wide, base truncate, circular truncate or nearly cordate, apex acute or slightly acute, edges rolling downwards when dry; male cones ca. 4–7 mm; seeds obovate-elliptic or obovoid, 2.2–2.8 cm long *C. hainanensis*

1. *Cephalotaxus oliveri* Masters (1898: 270). Lectotype (designated by Farjon 2010): CHINA. Hubei: Changyang T. Z., 1889, A. Henry 7479 (lectotype K!, isolectotypes US!, E!, B!); Changyang County, unknown date, A. Henry 7843 (syntype G, *n.v.*). (Photo 1)

Cephalotaxus griffithii sensu Oliver in Hook. Icon. Pl. 20: t. 1933 (1890) non Hooker (1888).

Shrubs or small trees to 7 m tall; bark yellow to grayish brown. Leafy branchlets oblong-elliptic in outline, planar, 7–9 × 3.5–5.0 cm; leaves borne at 45–70° to branchlet axis; petioles ca. 0.5 mm. Blades linear-lanceolate, straight or very slightly falcate, hard and leathery, strongly convex, 1.5–3.2 cm × 2.3–3.2 mm; midveins ca. 0.8–1.0 mm wide; stomatal bands on abaxial surface 0.8–1.0 mm wide, with 13–17 rows of stomata, as wide as midvein and marginal bands; marginal bands ca. 0.8 mm wide; bases shallowly cordate or cordate-truncate; margins flat, apices obtuse, shortly cuspidate. Pollen cone capitula axillary, borne on lower side and toward distal end of terminal branchlets; buds developing before the subtending leaves expand; microsporophylls 6–10, each with 3 or 4 pollen sacs. Seeds cones solitary, peduncle ca. 6 mm. Seeds obovoid, ovoid, or almost globose, 2.2–2.7 × 1.4–1.8 cm, apex with small mucro; mature fruits with aril separate from testa. Pollination March–April, seeds maturing August–October. Cotyledons 2, germination hypogeal.

Iconography citation:—Cheng *et al.* (1978: 435): plate 99, figures 3–7.

Distribution and habitat:—Evergreen broad-leaved forests; 300–2300 m. CHINA: Yunnan, Sichuan (especially Emei Mountain), Chongqing, Guizhou, Hunan, Hubei, Jiangxi, Guangxi, Guangdong. (Figure 1).

Taxonomic notes:—This very distinct species can be identified by its leaves with a cordate-truncate base with margins in contact with each other, by its mature fruits with the aril separate from the testa, and by its cotyledons being retained in the soil when the seeds germinate (Ye 1993, and personal observation). This species is said to also grow in Laos and Vietnam (Fu 1984, Newman *et al.* 2007), but no specimens were cited to support this. Hiep & Vidal (1996) recorded only one species of *Cephalotaxus* from Laos and Vietnam, which they called *C. mannii*. In their treatment of *C. mannii* they included Indo-Chinese specimens that had previously been named as '*C. oliveri*' as synonym and suggested that the name *C. oliveri* had been misapplied to *C. mannii* from Indo-China. However, we checked specimens of Vietnam (deposited in P: *M. Poilane* 17284, 18906, 26613, 10266, 13622, 30090, 13543, 32914, 35983, 24049, 24056, *M. Balansa* 4201, *A. Chevalier* 40374, *M. Jacquet* 619) cited by Hiep & Vidal (1996) to study which taxon was treated as *C. mannii*, and found that none of these specimens are *C. oliveri*, but some specimens (*M. Poilane* 35983, 13543, *A. Chevalier* 40374, *M. Jacquet* 619) belong to *C. hainanensis*. Perhaps *C. oliveri* is endemic to China, and we support that in Vietnam the genus includes *C. hainanensis* and *C. harringtonii*.



PHOTO 1. *Cephalotaxus oliveri*.

Representative specimens:—CHINA. Sichuan: Meishan County, Emei Mountain, 15 October 1952, *W. P. Fang et al.* 33196 (PE); Meishan County, 28 September 1939, *T. N. Liou & C. Wang* 942 (PE); Meishan County, 1952, *J. H. Xiong & X. S. Zhang* 3276 (PE); Meishan County, 22 May 1964, *Sichuan Exped. Team* 733 (PE); Meishan County, 29 August 1957, *G. H. Yang* 57003 (PE). Meishan County, 14 July 1930. *W. P. Fang* 7566 (E). Chongqing: Nanchuan County, Jinfo Mountain, 14 May 1994, *Z. Y. Liu* 14774 (PE). Yunnan: Pingbian Miao County, 19 October 1939, *Q. W. Wang* 82612 (PE); Pingbian Miao County, 19 July 1934, *H. T. Tsai* 62795 (PE); Hekou Yao County, 1 May 1959, *Biology Department of Yunnan University* 1218 (IBK). Guizhou: Jiangkou County, Fanjing Mountain, 10 September 1986, *Sino Amer. Exped.* 1041 (PE); Liping County, 3 July 1975, *Y. Y. Xu* 75384 (PE); Suiyang County, 4 August 1939, *B. Q. Zhong* 426 (PE). Hunan: Zhangjiajie, no date, *L. G. Fu s. n.* (PE); Hengshan County, 20 September 2001, *Z. H. Hu* 354 (PE); Shimen County, 7 July 1987, *Huping Mountain Exped. Team* 01081 (PE). Hubei: Changyang County, 24 July 1939, *T. P. Wang* 11374 (PE); Enshi County, 16 June 1958, *H. J. Li* 2935 (PE); Changyang County, 1889, *A. Henry* 7832 (K); Changyang County, 1000 ft, May 1900, *E. H. Wilson* 72 (A). Jiangxi: Nanfeng County, 18 April 1965, *X. X. Yang* 650234 (PE). Guangxi: Longsheng County, 6 August 1957, *H. F. Tan & Z. T. Li* 70956 (IBK). Guangdong: Renhua County, 2 September 1958, *L. Deng* 7428 (PE).

2. *Cephalotaxus griffithii* Hooker (1888: 648). Lectotype (**designated here**): INDIA. Assam: Mishmi Hill, 1863–1864, *W. Griffith* 5000 (K!, isoelectotypes A!, B!, P!); INDIA. Manipur: on the way to Kohima, 23 February 1882, elev. 6000 ft, *G. Watt* 6166 (syntype E-00112583!, E-00112584E!, K!, P!); INDIA. Manipur: Khongui, elev. 6000 ft, 26 April 1882. *G. Watt* 6759 (syntypes E!, P-00731284!, P-00731285!). (Photo 2)

Cephalotaxus lanceolata K.M.Feng in Cheng *et al.* (1975: 86), *nom. illeg. non hort. ex Beißner* (1901: 73–74 & 117).
Cephalotaxus fortunei var. *lanceolata* (K.M.Feng) Silba (1990: 27). Type: CHINA. Yunnan: Gongshan Dulong County, Dulongjiang Township, elev. 1900 m, 18 June 1959, *G. M. Feng* 24347 (holotype PE!).

Trees to 20 m tall; trunk to 40 cm dbh; bark purple, smooth; branches pendulous. Leafy branchlets resembling 2 adjacent parallelograms in outline, broadly ‘V’-shaped in cross section, apex abruptly truncate; leaves spreading horizontally at ca. 45° to branchlet axis; petiole very short. Blades dark green adaxially, lanceolate or linear-lanceolate, distally tapered, straight or slightly falcate, 4.5–10.0 cm × 4–7 mm, thin textured and leathery; abaxial stomatal bands white, bases rounded; margins revolute; apices long acuminate. Pollen cone capitula axillary, solitary, each of 6 or 11 cones, 3–7 mm in diam., peduncle ca. 3–6 mm with several spirally arranged scales; microsporophylls 6–13, each with 2–4 pollen sacs. Seeds cones with peduncle 1.5–2 cm long at maturity; aril turning greenish brown when ripe. Seeds obovoid-ellipsoid, 3.5–4.5 cm long, maturing September–November.

Iconography citation:—Cheng *et al.* (1978: 425): plate 96, figure 1.

Distribution and habitat:—Broad-leaved forests, scattered; ca. 1900 m. CHINA: NW Yunnan, Gongshan Dulong County, banks of upper Dulongjiang River; BURMA; NE INDIA (Figure 1).

Taxonomic notes:—Feng characterized *C. lanceolata* in a paper of Cheng *et al.* (1975) as having lanceolate leaves with rounded bases and it can be distinguished from *C. fortunei* Hooker (1850: 76) on the basis of its wider, thinner needles with sharper acute apices. Later, Silba (1990) treated *C. lanceolata* as *C. fortunei* var. *lanceolata*. Unfortunately, *C. lanceolata* is an illegitimate name, a later homonym of the name *C. lanceolata* hort. ex Beißner (1901: 73–74 & 117), according to Art. 53.1 and Art. 45.3 of the Vienna Code (McNeill *et al.* 2006). However, one of the syntypes of *C. griffithii* (Figure 3) and the holotype of *C. lanceolata* (Figure 4) are identical in the shape and size of their leaves and in the other essential characters which Feng used to distinguish his species. So the earlier specific name *C. griffithii* should be adopted. Hu (1964) regarded *C. griffithii* as a synonym of *C. harringtonii* and Fu (1984), Hiêp & Vidal (1996), Fu *et al.* (1999a) and Farjon (2010) treated *C. griffithii* as a synonym of *C. mannii*, but the type specimens of *C. griffithii* (Figure 3), *C. harringtonii* (Figure 13) and *C. mannii* (Figure 16) are here compared, indicating that

C. griffithii should be maintained as a distinct species, because it has lanceolate leaves with rounded bases unlike *C. mannii* and *C. harringtonii* that lack this characteristic.

Representative specimens:—CHINA. Yunnan: Gongshan Dulong County, 20 August 2006, elev. 1970 m, *Gaoligongshan Biodiversity Survey 32632* (HAST). BURMA. Kayah: Between Ning W'Krok and Kanang, on the eastern aspects of Gwe-Kya-Kat-Bum, elev. 4000–5000 ft, 20 January 1962, *J. Keenan, U Tun Aung & U Tun Hla 3338* (E); Hills north west of Kanang, elev. 4000–5000 ft, 14 March 1962, *J. Keenan, U Tun Aung & U Tun Hla 3860* (E). Chin: Victoria Mountain, elev. 9000 ft, 2 April 1956, *F. Kingdon-Ward 21916* (E).



PHOTO 2. *Cephalotaxus griffithii*.



FIGURE 3. One of the syntypes of *C. griffithii* (part, *Griffith 5000, A*).



FIGURE 4. The holotype of *C. lanceolata* (part, *Feng 24347, PE*).

3. *Cephalotaxus fortunei* Hooker (1850: 76) (as '*fortuni*'). Type: CHINA. Shaanxi: 200 miles north of Shang-see, no date, *R. Fortune s.n.* (holotype K!). (Photo 3).

Cephalotaxus fortunei var. *concolor* Franchet (1899: 265). Lectotype (**designated here**): CHINA. Chongqing: Chengkou

County, no date, *R. P. Farges s.n.* (P! (includes 5 little branches), isolectotypes E-00465207!, E-00465208!, K-000552830!, P! (includes 3 little branches)).

Trees to 20 m tall; trunk to 30 cm or more dbh.; bark dark reddish brown, peeling in strips. Leafy branchlets obovate, obtriangular or rectangular in outline, planar or drooping, 4–21 × 3–20 cm; leaves borne at 30–110° to branchlet axis; petioles 0.5–2.0 mm. Blades deep green and glossy adaxially, linear-lanceolate, distally gradually attenuate, falcate or straight, flat, 1.5–16.0 cm × 1.5–7.5 mm, leathery but usually rather soft and flexible; midvein 0.2–0.5 mm wide abaxially; stomatal bands 0.8–2.2 mm wide, usually with 13–24 rows of stomata, 2–5 × as wide as midvein; marginal bands 0.1–0.4 mm wide; bases cuneate or shortly attenuate, asymmetrical; margins flat or very narrowly revolute when dry; apices cuspidate, cusp 0.5–2.0 mm, often breaking off. Pollen cone capitula of 6–14 cones, distinctly pedunculate (peduncle 2–8 mm), globose, 6–10 mm in diam.; bracts ovate, ca. 2.0 × 2.5 mm, margin entire or erose, apex acute; microsporophylls 6–16, each with 3 or 4 pollen sacs. Seed cones borne 3–10 together, peduncle 3–12 mm; seed scales ca. 1.5 mm; aril yellow or green initially, turning purple when ripe. Seeds ellipsoid, 1.3–2.4 × 0.7–1.4 cm. Pollination April–May, seeds maturing June–October.

Iconography citation:—Cheng *et al.* (1978: 425): plate 96, figures 2–6.



FIGURE 5. Holotype of *C. fortunei* (part *Fortune s.n.*, K).



FIGURE 6. Isotype of *C. fortunei* var. *concolor* (part, *Farges s.n.*, K).

Distribution and habitat:—Mixed, coniferous, and broad-leaved forests, thickets, roadsides; 200–3000 m. CHINA: Yunnan, Sichuan, Chongqing, Shaanxi, Guizhou, Guangdong, Guangxi, Fujian, Jiangxi, Zhejiang, Anhui, Henan, Hunan, Hubei; perhaps BURMA and LAOS. (Figure 2).

Taxonomic notes:—As discussed by Lang *et al.* (2011b), the specific epithet of this species, ‘*fortuni*’, should be corrected as ‘*fortunei*’. We accept the treatment of *C. fortunei* var. *concolor* (Figure 6) as synonym of *C. fortunei* (Figure 5) as done in the *Flora of China* by Fu *et al.* (1999a). This species is endemic to China according to a literature review. However, it is said that it also occurs in Burma and Laos (Kress *et al.* 2003, Farjon 2010), but we have not seen any specimens from there. *Cephalotaxus fortunei* is similar to *C. alpina* in general appearance but can be distinguished by its larger, linear or lanceolate-linear leaves with a cuneate or broadly cuneate base; leaves are usually pendulous or horizontal, 3.5–7.5 mm wide, up to 16 (4–16) long; it can also be distinguished by its 1.4–2.8 cm long, 0.9–1.5 cm wide, 0.6–1 cm thick seeds, with a width to thickness ratio 1.26–1.97, and by male cones of 6–8 mm long.

Representative specimens:—CHINA. Yunnan: Heqing County, 14 August 1940, *R. C. Qin 23648* (PE). Sichuan: Meishan County, Emei Mountain, 18 July 1952, *W. P. Fang et al. 31716* (PE); Pingshan County, 10 June 1934, *T. T. Yu 3007* (PE); Gulin County, 7 September 2010, *PE-Gulin Expedition Team 0962* (PE); Hanyuan County, 12 September 1930, *W. P. Fang 9042* (E). Chongqing: Nanchuan County, 21 April 1981, *Z. Y. Liu 1417* (PE); Wuxi County, 3 July 1958, *G. H. Yang 58690* (PE). Shaanxi: Liuba County, 15 October

1952, *K. J. Fu* 6214 (PE); Yang County, 26 July 1952, *K. J. Fu* 5225 (PE). Guizhou: Anlong County, 23 June 1960, *Guizhou team* 4921 (IBK); Weining County, 7 July 1959, *Bijie Team* 86 (PE); Liping County, 17 July 1937, *B. Q. Zhong* 1156 (PE). Guangxi: Lingui County, 23 June 1952, *C. F. Liang* 30400 (PE); Longsheng County, 20 November 1957, *Y. C. Chen* 600057 (IBK). Guangdong: Ruyuan Yao County, 9 July 1933, *X. P. Gao* 53010 (IBK); Lechang County, 30 November 1932, *W. T. Tsang* 20711 (PE). Fujian: Chong' an County, 16 April 1955, *M. J. Wang* 3248 (PE); Jianning County, 3 June 1978, *Z. Y. Li* 10888 (PE). Jiangxi: Lichuan County, 13 October 1957, *M. J. Wang* 2273 (PE); Xunwu County, 22 August 1962, *J. S. Yue* 2047 (PE). Zhejiang: Suichang County, 27 April 1959, *Zhejiang Plant Resources Investigation Team* 25727 (PE). Anhui: Xiuning County, 30 June 1959, *Anonymous* 2698 (PE); Qingyang County, Jiuhua Shan, 28 April 1925, *R. C. Ching* 2592 (K). Henan: Xin County, 9 July 1984, *Plant Resources Investigation Team* 792 (PE). Hunan: Ninyuan County, 9 July 1959, *P. X. Tan* 62032 (IBK); Shimou County, 22 June 1987, *Huping Mountain Exped. Team* 0598 (PE). Hubei: Zigui County, 17 September 2007, *C. M. Zhao* EX1094 (PE). USA. New York: Cultivated at New York Botanical Garden, 1 September 1999, *T. A. Zanoni* 47259 (NY); Cultivated at Suffolk Co. Roslyn Nursery, Dix Hills, 22 August 2005, *J. Silba* B-566 (NY).



PHOTO 3. *Cephalotaxus fortunei*.

4. *Cephalotaxus alpina* (Li) Fu (1984: 282). *Cephalotaxus fortunei* var. *alpina* Li (1953: 164). Type: CHINA. Yunnan: Weixi Lisu County, Mekong-Yangtze divide, Litiping Mountain Range, 1923, *J. F. Rock* 11572 (holotype A!). (Photo 4)

C. fortunei var. *globosa* S.Y.Hu (1964: 28). Type: CHINA. Yunnan: Weixi Lisu County, Tie so, Hoa-Kiao-pin, 18 June 1916, *Siméon Tén* 161 (holotype A!, isotype E!).

Evergreen shrubs or small trees, 2–13 m high. Trunk to 10–20 cm or more dbh; bark dark reddish brown, peeling in strips. Leaves 1.5–13.0 cm (mean ca. 8cm) long, 2.0–3.5 mm (mean ca. 3mm) wide, borne at 40–70° to branchlet axis, upward ‘V’-shaped in cross usually. Pollen cones sessile or subsessile, peduncles 0–2 mm; aril with prominent longitudinal ridges. Seeds ellipsoid, 1.2–2.3 cm long, 0.7–1.2 mm wide and 0.7–1.0 mm thick. Pollination March–May, seeds maturing September–November.

Iconography citation:—Lang *et al.* (2011a: 505): Appendix-plant pictures of *Cephalotaxus*: *C. alpina*.

Distribution and habitat:—Mixed forests, thickets by streams; ca. 1800–3700 m. CHINA: S Gansu, N and W Sichuan, W and N Yunnan. (Figure 1).



PHOTO 4. *Cephalotaxus alpina*.

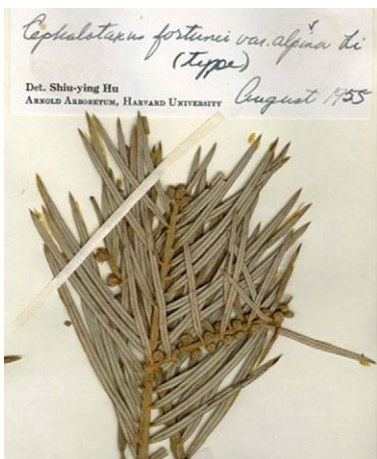


FIGURE 7. The holotype of *C. fortunei* var. *alpina* (part, Rock 11572, A).



FIGURE 8. The holotype of *C. fortunei* var. *globosa* (part, Tén 161, A).

Taxonomic notes:—This species superficially resembles *C. fortunei*. Lang *et al.* (2012) compared morphology of seeds and leaves of *C. fortunei* to *C. alpina* and suggested the width/thickness ratio of seeds as well as leaf width of *C. alpina* and *C. fortunei* being highly significant differences. These differences do not intergrade and can be used to clearly distinguish *C. alpina* from *C. fortunei* at the population level. *Cephalotaxus alpina* differs also from *C. fortunei* by its sessile pollen cones, which may be sessile with a peduncle 0–2 mm long, while male strobili of *C. fortunei* were distinctly pedunculate with peduncles 2–8 mm long. These differences suggest *C. fortunei* var. *alpina* should be elevated to species rank. Additionally the

characteristics of the holotype of *C. fortunei* var. *globosa* (Figure 8) and the holotype of *C. fortunei* var. *alpina* (Figure 7) share similarities, indicating that *C. fortunei* var. *globosa* should be treated as a synonym of *C. alpina*.

Representative specimens:—CHINA. Yunnan: Dongchuan, 3 November 1984, *S. B. Lan* 318 (PE); Luquan Yi County, 20 May 1952, *P. Y. Mao* 912 (IBK); Weixi Lisu County, 3 June 1940, *K. M. Feng* 4392 (PE); Weixi Lisu County, July 1935, *Q. W. Wang* 64281 (PE); Yulong County, Mountains south of Likiang, Sungkwe Hochin Range, 01 July 1923, *J. F. Rock* 8298 (E-00094612, E-00094613). Sichuan: Mianning County, 25 July 1959, *S. G. Wu* 2170 (PE); Mianning County, 21 September 1960, *J. S. Yin* 4327 (PE); Mianning County, 24 May 1960, *South-to-North Water Transfer Project Team* 5811 (PE); Leibo County, 25 June 1959, *Z. T. Guan* 8686 (PE); Yanbian County, 25 June 1983, *Qinghai-Xizang Team* 11441 (PE). Gansu: Kang County, 6 August 1995, *Y. S. Lian* 95278 (PE); Wen County, 29 April 2007 *Baishuijiang Team* 3763 (PE); Zhouqu County, 22 May 1959, *South-to-North Water Transfer Project Team* 425 (PE).

5. *Cephalotaxus nana* Nakai (1919: 193). *Cephalotaxus drupacea* var. *nana* (Nakai) Rehder (1923: 107). *Cephalotaxus harringtonii* var. *nana* (Nakai) Rehder (1941: 569). Lectotype (**designated here**): JAPAN. Yeso [Hokkaido]: Prov. Siribeshi, Takashima, August 1888, *Jinzo Matsumura s.n.* (lectotype TI!); JAPAN. Yeso [Hokkaido]: Prov. Siribeshi, Sapporo, 9 August 1891, *Ryokichi Yatabe s.n.* (syntype TI!). (Photo 5).

Cephalotaxus sinensis var. *latifolia* Cheng & Fu (1975: 86), *nom. inval.* (Art. 8.1, 37.1 of the 2006 Vienna Code). *Cephalotaxus latifolia* (W.C.Cheng & L.K.Fu) Fu (1984: 280), *nom. inval.* (Art. 8.1, 37.1 of the 2006 Vienna Code). *Cephalotaxus latifolia* Fu & Mill (1999: 185). *Cephalotaxus harringtonii* var. *latifolia* (W.C.Cheng & L.K.Fu) Silba (2000: 22), *nom. inval.* *Cephalotaxus sinensis* subsp. *latifolia* (L.K.Fu & R.R.Mill) Silba (2007: 16). Type: CHINA. Chongqing: Nanchuan County, Jinfo Mountain, 23 May 1964, *X. Q. Chen & K. Y. Lang* 02463 (holotype PE!).

Cephalotaxus harringtonii subsp. *hokkaidoensis* Silba (2007: 9). Type: CULTIVATED. USA. Massachusetts: Jamaica Plain, cultivated at the Arnold Arboretum (from seeds collected in the wild: Japan, Hokkaido, Uryi Experimental Forest, Uryu-gun, elev. 140 m), 25 April 2007, *J. Silba B-622* (holotype NY!).

Cephalotaxus drupacea var. *sinensis* f. *globosa* Rehder & Wilson (1914: 4). *Cephalotaxus sinensis* f. *globosa* (Rehder & Wilson) Li (1953: 163). Type: CHINA. Hubei: Hsing-shan Hsien (Xingshan County), woods, brush 3 m, elev. 1000 m, August 1907, *E. H. Wilson* 163 (holotype A!, isotype K!).

Cephalotaxus nana var. *astringens* Nakai (1919: 193). Type: JAPAN. Hondo: Prov. Aidzu, Iwashiro, in montibus, no date, *T. Nakai s.n.* (holotype TI!).

Cephalotaxus koreana Nakai (1930: 508). *Cephalotaxus drupacea* var. *koreana* (Nakai) Hatusima (1934: 38). *Cephalotaxus harringtonii* var. *koreana* (Nakai) Rehder (1941: 569). *Cephalotaxus harringtonii* subsp. *koreana* (Nakai) Silba (2007: 18). Lectotype (**designated here**): SOUTH KOREA. Prov. Zennan: in monte Hakuyozan tractus Chōjyō, 4 June 1928, *T. Nakai* 10720 (TI!).

Shrubs or small trees to 4 m tall; bark grayish brown; branches stout. Leafy branchlets oblong in outline, planar, 5.5–9.0 × 4–5 cm; leaves borne at 60–85° to branchlet axis, sessile but decurrent for whole length of internode. Blades dark olive green adaxially, linear, straight, 1.6–3.0 cm × 2.8–7.0 mm, thick and leathery; midveins raised adaxially and bordered on each side by a paler, longitudinal channel, strongly raised abaxially, 0.25–0.50 mm wide; stomatal bands white, 0.8–1.0 mm wide, with 11–15 rows of stomata, ca. 2–3 × as wide as midvein; marginal bands green, ca. 0.3 mm wide; bases cuneate or round, slightly asymmetrical; margins flat (slightly revolute when dry), apices abruptly mucronate, mucro 0.2–0.4 mm. Pollen cone capitula axillary on lower side of branchlet axis; peduncle 1.5–2.5 mm, scaly; bracts ca. 9, ovate, in 4 rows; apical bracts ca. 0.7 × 0.3 mm, apex mucronate. Seeds cones borne 2–8 together, peduncle 2–4 mm. Seeds obovoid, 1.8–2.0 cm, apex with small mucro at center. Pollination May, seeds maturing September–November.

Iconography citation:—Cheng *et al.* (1978: 431): plate 98, figures 2–3.

Distribution and habitat:—Thickets in mountainous areas; 200–2500 m. CHINA: Sichuan, Chongqing, Guizhou, Guangxi, Hubei, Hunan, Fujian; JAPAN; SOUTH KOREA (Figure 2).



PHOTO 5. *Cephalotaxus nana*.

Taxonomic notes:—According to Fu *et al.* (1999) the 1975 and 1984 synonyms *C. sinensis* var. *latifolia* and *C. latifolia* were not validly published, because both male and female type specimens were cited in the 1975 and 1984 publications. Also, Rehder & Wilson (1914) in the protologue of *C. drupacea* var. *sinensis* f. *globosa* mentioned that it may prove to be identical to *C. pedunculata* var. *sphaeralis* Masters (1884: 113, 1887: 203), but no further comments can be made. Nevertheless, a syntype of *C. nana* (Figure 9) is similar to *C. latifolia* (Figure 10), *C. drupacea* var. *sinensis* f. *globosa* (Figure 11), *C. harringtonii* subsp. *hokkaidoensis* (Figure 12) and *C. koreana* (Figure 13) in the shape and size of the leaves and they are all shrubs 1–4 m high with the leaf apices often convex acuminate or acute, bases rounded, leaves 2.5–3.5 cm long, 3.5–6.0 mm wide, which can be easily distinguished from the other taxa of *Cephalotaxus*. Therefore, in the present paper *C. drupacea* var. *sinensis* f. *globosa* and the later taxa (*C. nana* var. *astringens*, *C. koreana*, *C. latifolia* and *C. harringtonii* subsp. *hokkaidoensis*,) are hereby synonymized with *C. nana*.



FIGURE 9. A syntype of *C. nana* (part, Matsumura s.n., TI).



FIGURE 10. The holotype of *C. latifolia* (part, Chen & Lang 2463, PE).



FIGURE 11. The holotype of *C. drupacea* var. *sinensis* f. *globosa* (part, Wilson 163, A).



FIGURE 12. The holotype of *C. harringtonii* subsp. *hokkaidoensis* (part, Silba B-622, NY).



FIGURE 13. A syntype of *C. koreana* (part, Nakai 10720, TI).

Representative specimens:—CHINA. Guizhou: Jiangkou County, 22 June 1988, *Wulinshan Exped. Team 1280* (PE); Shiqian County, 2 August 1988, *Wulinshan Exped. Team 2926* (PE). Hunan: Xinshao County, 27 August 2005, *B. Y. Li 6219* (PE). Hubei: Hefeng County, 17 August 1958, *H. J. Li 5644* (PE). Chongqing: Nanchuan County, 3 July 1986, *Jinfo Mountain Exped. Team 1489* (PE); Wuxi County, 2 October 1988, *Y. D. Chen 2100* (PE). Guangxi: Guanyang County, 5 October 1958, *Z. Z. Chen 52496* (IBK); Xingan County, 13 November 1956, *S. L. Yu 900177* (IBK). Fujian: Luoyuan County, 27 November 1957, *L. Deng 5869* (PE). JAPAN. Chubu: Gifu Pref., Kaore Valley, 16 August 1964, *Y. Inamasu & M. Hottawa 124* (K). Kanto: Gunma Pref., Tanigawa Mountain, 16 July 1973, *S. Kurata & T. Nakai 10021* (K). SOUTH KOREA. South Jeolla: Gangjin County, Woluchusan, 1997, *D. Hinkley 20050102* (UC). USA. California: Cultivated at Berkeley Botanical Garden, 1 April 1997, *N. C. Goldstein & H. Forbes 166* (NY).

6. *Cephalotaxus harringtonii* (Knight ex J.Forbes) Koch (1873: 102). *Taxus harringtonii* Knight ex Forbes (1839: 217) (as ‘*harringtonia*’). *Cephalotaxus drupacea* var. *harringtonii* (Knight ex J.Forbes) Miq. in Pilger (1903: 102). Holotype: MALAYSIA. the illustration in Forbes & Bedford (1839), plate 66. (Photo 6).

Cephalotaxus drupacea Siebold & Zucc. ex Endl. (1847: 239). *C. harringtonii* var. *drupacea* (Sieb. & Zucc. ex Endl.) Koidzumi (1930: 98). *C. harringtonii* f. *drupacea* (Sieb. & Zucc. ex Endl.) Kitamura (1974: 9). *C. harringtonii* subsp. *drupacea* (Sieb. & Zucc. ex Endl.) Silba (2007: 7). Type: described from near Nagasaki, Japan; no type designated. *Cephalotaxus pedunculata* Siebold & Zucc. ex Endlicher (1847: 238). *nom. illeg. pro syn. Cephalotaxus drupacea* var. *pedunculata* Miquel (1867: 169). Type: as for *C. harringtonii*.

Cephalotaxus mannii Hooker (1886: t. 1523). Type: INDIA. Meghalaya: Khasia Mountains, Lankhla woods, elev. 5000 ft, 1 November 1885, *G. Mann s.n.* (holotype, K!, isotype A!, E!, US!, P!, PH!).

Cephalotaxus drupacea var. *sinensis* Rehder & Wilson in Sargent (1914: 3). *Cephalotaxus harringtonii* var. *sinensis* (Rehder & Wilson) Rehder (1941: 569). *Cephalotaxus sinensis* (Rehder & Wilson) Li (1953: 162). Lectotype (**designated here**): CHINA. Sichuan: Baoxing County, Mupin Township, woodlands, elev. 1000–1300 m, September 1908, *E. H. Wilson 1115* ♀ (lectotype A!, isolectotype E-00112544!, E-00112546!, US!); Mao County, Chiu-ting-shan (Jiuding Mountain), thickets, elev. 2000 m, 23 May 1908, *E. H. Wilson 1115* ♂ (syntype A!).

Cephalotaxus wilsoniana Hayata (1914: 22). *Cephalotaxus harringtonii* var. *wilsoniana* (Hayata) Kitamura (1974: 9). *Cephalotaxus sinensis* var. *wilsoniana* (Hayata) Fu & Li (1997: 263). *Cephalotaxus sinensis* subsp. *wilsoniana* (Hayata) Silba (2007: 18). Type: TAIWAN. Alisan (Ali Mountain), September 1912, *K. Uyematsu 18* (holotype TI!).

Cephalotaxus pedunculata var. *sphaeralis* Masters (1884: 113, 1887: 203). *Cephalotaxus drupacea* var. *harringtonii* f. *sphaeralis* (Masters) Pilger (1903: 103). *C. harringtonii* var. *sphaeralis* (Masters) Rehder (1914: 716). *C. drupacea* var. *sphaeralis* (Masters) Pilger (1916b: 22). Lectotype (**designated here**): CULTIVATED. U.K. Sussex: Steyning, cultivated at the garden of Rev. J. Goring (Mr. Goring obtained this material from a nursery in Bagshot, Surrey in 1865 or 1866), 19 January 1884, *M. T. Masters s.n.* (lectotype K-13188!).

Cephalotaxus griffithii sensu Phengklai, Fl. Thail. 2(2): 195 (1972) non Hooker (1888).

Trees to 10(–16) m tall; trunk to 30–60 cm dbh; bark reddish, gray or grayish brown. Leafy branchlets elliptic, oblong, or more usually obovate-rectangular in outline, planar, 6–19 × 4–10 cm; leaves borne perpendicular to branchlet axis or directed forward at 45–95°, petioles 0–2 mm. Blades green adaxially, linear or linear-lanceolate, parallel sided almost throughout length and tapered from near apex only, or tapered from point above middle of blade but well below apex, straight or very slightly falcate, flat, 1–8 cm × 2.0–4.5 mm, 7–10 × as long as wide, leathery but relatively soft; midveins 0.2–0.6 mm wide abaxially; stomatal bands white, 0.8–1.2 mm wide, 2–4 × as wide as midvein; marginal bands 0.1–0.3 mm wide; bases cuneate or rounded-cuneate, symmetrical or very slightly asymmetrical; margins narrowly revolute, apices acute and shortly mucronate to long acuminate. Pollen cone capitula globose, 4–7 mm in diam., each of 6 or 7 pinkish brown cones; peduncle ca. 3 mm, naked except at apex; microsporophylls 4–11, each with 2–4 pollen sacs. Seed cones solitary, or borne 2–10 together, peduncle 3–8 mm; seed scales grayish green, ovate, apex shortly cuspidate; aril red or reddish purple when ripe, with 6 prominent, longitudinal ridges. Seeds ovoid or obovoid to ellipsoid, 1.8–2.5 × 0.9–1.2 cm, apex mucronate or cuspidate. Pollination March–June, seeds maturin June–November.

Iconography citation:—Cheng *et al.* (1978: 431): plate 98, figure 1; Li & Keng (1994: 556): plate 215.



PHOTO 6. *Cephalotaxus harringtonii*.



FIGURE 14. The holotype of *C. harringtonii* (part, from *Pinet. Woburn.* 217. t. 66. 1839).



FIGURE 15. Illustration of *C. drupacea* (part, from *Fl. Jap.* II. t. 130-131. 1870).



FIGURE 16. Illustration of *C. pedunculata* (part, from *Fl. Jap.* II. t. 132. 1870).

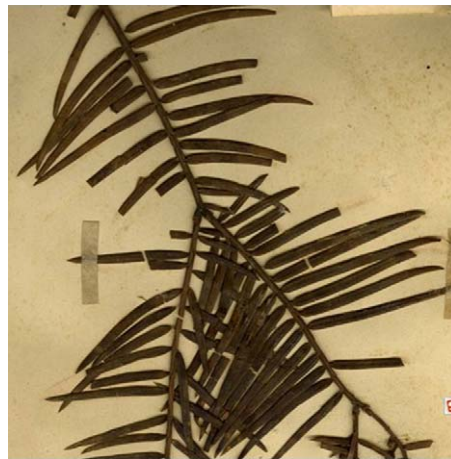


FIGURE 17. The holotype of *C. mannii* (part, *Mann s.n.*, K).



FIGURE 18. A lectotype of *C. drupacea* var. *sinensis* ♀ (part, *Wilson 1115*, A).



FIGURE 19. The holotype of *C. wilsoniana* (part, *Uyematsu 18*, TI).



FIGURE 20. The lectotype of *C. pedunculata* var. *sphaeralis* (part, *Masters s.n.*, K).



FIGURE 21. The holotype of *C. hainanensis* (part, *Chun & Tso 44183*, US).



FIGURE 22. The holotype of *C. harringtonii* var. *thailandensis* (part, *Abbe et al. 9477*, NY).

Distribution and habitat:—Montane coniferous or mixed forests, thickets, stream valleys, valley bottoms, open situations, on granite, sandstone, and limestone substrates; 600–3000 m. CHINA; TAIWAN; SOUTH KOREA; JAPAN; NE INDIA; BURMA; LAOS; THAILAND; VIETNAM; MALAYSIA. (Figure 1).

Taxonomic notes:—*Cephalotaxus harringtonii* (Figure 14), *C. drupacea* (Figure 15), *C. pedunculata* (Figure 16), *C. mannii* (Figure 17), *C. drupacea* var. *sinensis* (Figure 18), *C. wilsoniana* (Figure 19) and *C. pedunculata* var. *sphaeralis* (Figure 20) are difficult to distinguish and based on specimens collected in Malaysia, Japan, India, China and Taiwan. In the past, these taxa were identified mainly by their geographic distribution, often delimited by political boundaries. However, type specimens or original illustrations of *C. harringtonii*, *C. drupacea*, *C. pedunculata*, *C. mannii*, *C. drupacea* var. *sinensis*, *C. wilsoniana* and *C. pedunculata* var. *sphaeralis* are extremely similar in leaf shape and size, strongly suggesting that these taxa all represent one and the same species and so they are synonymized under the earliest epithet available for this species: *C. harringtonii*. The original epithet, ‘*harringtonia*’, has an improper Latin termination that should be corrected as ‘*harringtonii*’, according to Article 60.7, Ex.15 of the ICBN (McNeill *et al.* 2006). Hiệp & Vidal (1996) treated Indo-Chinese specimens of *C. harringtonii* under *C. mannii*, the only species they recognized for Laos and Vietnam. We do not agree with Hiệp & Vidal, but think that *C. mannii* is a synonym of *C. harringtonii*.

Representative specimens:—CHINA. Yunnan: Fuming County, 24 May 1964, *B. Y. Qiu 59182* (IBK); Malipo County, 12 January 1940, *Q. W. Wang 83125* (PE). Gansu: Wudu County, 18 June 1959, *Z. Y. Zhang 5036* (PE); Zhouqu County, 22 September 1958, *Y. Q. He 842* (PE). Shaanxi: Taibai County, 6 December

1936, *T. P. Wang 6349* (PE); Lantian County, 18 October 1958, *G. X. Su 510* (PE). Sichuan: Meigu County, 1 August 1959, *Z. T. Guan 9098* (PE). Chongqing: Wulong County, 29 June 1988, *F. D. Pu & Y. L. Cao 0280* (PE). Guizhou: Jiangkou County, 29 August 1986, *Sino-Amer. Exped. Team 651* (PE). Hubei: Hefeng County, 16 August 1958, *H. J. Li 6171* (PE); Xing Shan County, September 1907, *E. H. Wilson 167* (K). Hunan: Sangzhi County, 18 July 1988, *L. Q. Li 167* (PE). Guangxi: Huanjiang Maonan County, 16 August 1994, *F. N. Wei 2214* (IBK). Guangdong: Xinyi County, 1 December 1934, *Z. Huang 38131* (IBK). Hainan: Ledong County, 11 June 1976, *Y. Y. Chen 10* (PE); No locality, 20 February 1934, *H. Y. Liang 65025* (P); No locality and no time, *F. A. McClure 9361* (P-01660980). Henan: Song County, 9 August 1983, *Plant Resources Investigation Team 10189* (PE). Jiangxi: Anfu County, 8 September 1954, *Jiangxi Team 1155* (PE). Fujian: Chongan County, 2 August 1964, *Z. P. Jian 400852* (PE). Jiangsu: Liyang County, 17 September 1956, *M. B. Deng 2742* (PE). Zhejiang: Tiantai County, 1958, *G. Y. Chen 2348* (PE). Taiwan: Taichung County, 14 October 1957, *T. S. Liu et al. 357* (ANS); Nantou County, 9 February 1957, *Liu et Kou 609* (ANS); Hualien County, 16 August 1956, *Liu et al. 267* (ANS); No locality, 9 February 1918, *E. H. Wilson 9832* (K). JAPAN. Honshu: Shimane Pref., Kuroyama, 27 April 1978, *H. Ohashi et al. 1372* (PE); Pref. Shizuoka, Takakusa Mountain, 23 March 1997, *F. Konta 17996* (PE). Hondo: Zaozan Mountain in Echigo, 24 August 1956, *M. Togasi 1353* (PE). SOUTH KOREA. Jeollanam-do: Gurye-gun, Masan-Myeon, 28 May 2011, *H. W. Shin et al. 2011-0604* (KUS). THAILAND. Chiang Mai: Doi Suthep (peak), 24 November 1912, *A. F. G. Kerr 2797* (K). Chiang Rai: No locality and no date, *L. M. Makham 785* (K). Bangkok: Kao Krading, 14 March 1924, *A. F. G. Kerr 8750* (P). LAOS. Khammouan: North eastern slopes of Phou Yang, 17° 48' 36" N, 105° 32' 59" E, elev. 1000 m, 24 October 2005, *Newman et al. LAO 1009* (P). VIETNAM. Lam Dong (Lâm Đồng): Duc Trong, Xa Heip An (Elephant Mountain), elev. 1340–1500 m, 11° 50' 12" N, 108° 25' 26" E, 31 August 2001, *M. F. Gardener et al. 58* (E). Thanh Hoá: Lung Vân, elev. 1000 m, 5 February 1920, *M. Poilane 17284, 18906* (P). Hanoi: Ba Vi Mountain, 1888, *M. Balansa 4201* (P). Ben Tre (Bến Tre): Hon Rao et La Dua, elev. 600–700 m, 29 February 1928, *M. Poilane 13622* (P). Gia Lai: Dak Gley, 31 January 1947, *M. Poilane 32914* (P). BURMA. Kachin: Arahku, North Triangle, elev. 5000 ft, 25 November 1953, *F. Kingdon-Ward 21627* (E); Locality not very clear (barcode: E00112586), elev. 6000 ft, 13 April 1926, *R. Unwin 3001* (E). Chin: Mindat, Hilawng ridge, elev. 7000 ft, 11 November 1962, *U. Mg Gale (2) 9186* (E); Victoria Mountain, elev. 10000 ft, April 1939, *F. G. Dickason 8521* (E); Victoria Mountain, 26 May 1924, *R. E. Cooper 5954* (E).

7. *Cephalotaxus hainanensis* Li (1953: 164). Type: CHINA. Hainan: Wuzhishan City, Fanyang Township (Fan Yah), elev. 3500 ft, 1932–1933, *N. K. Chun & C. L. Tso 44183* (holotype US!, isotypes A!, NY!, K!, P!). (Photo 7)

Cephalotaxus harringtonii var. *thailandensis* Silba (2000: 22). *Cephalotaxus mannii* subsp. *thailandensis* (Silba) Silba (2007: 13). Type: THAILAND. Loey Province: Phukrading (Khao Kating), evergreen forest, SE slope, elev. ca. 3500 ft, 16° 55' 00" N, 101° 47' 00" E, 13 January 1960, *L. B. Abbe, E. C. Abbe & T. Smitinand 9477* (holotype NY!).

Trees to 20 m tall; trunk to 20–50 cm dbh; bark light brown to reddish brown, flaking off. Leafy branchlets elliptic or oblong-elliptic in outline, 7–25 × 4–10 cm, about 1/2 as wide as long; leaves borne at 50–85° to branchlet axis; petiole absent or 0.3–0.5 mm. Blades dark green or shiny olive green adaxially, linear or linear-lanceolate, usually straight, occasionally slightly falcate, flat, 1.5–4.0 cm × 2.5–4.0 mm, leathery or relatively thin; midvein prominent adaxially, 0.2–0.3 mm wide abaxially; stomatal bands white or bluish white, often indistinct and green when dry, 0.7–1.6 mm wide, with 19–26 rows of stomata, 2–8 × as wide as midvein; marginal bands 0.1–0.3 mm wide; bases very broadly obtuse or obtusely truncate, symmetrical or not; margins narrowly revolute; apices cuspidate, or abruptly and very shortly mucronate. Pollen cones borne 5–8 together, pale yellow, globose, 4.0–4.5 mm in diam., peduncle 1–5 mm, usually with at least 10 bracts; microsporophylls 7–13, each with 3 or 4 pollen sacs. Seed cones solitary or borne 2–8 together, peduncle 6–10 mm; aril green initially, turning red when ripe. Seeds obovoid-ellipsoid or obovoid, sometimes laterally

compressed, 2.2–2.8 cm; apex shortly mucronate or cuspidate. Pollination November–March, seeds maturing August–October.

Iconography citation:—Cheng *et al.* (1978: 429): plate 97, figure 2; Wu (1983: 395): figure 116.

Distribution and habitat:—Mixed forests and forested ravines; ca. 800–1200 m. CHINA: Hainan, Guangdong, Guangxi, Yunnan, SE Tibet; BURMA (new record); THAILAND (new record); VIETNAM. (Figure 2)

Taxonomic notes:—The description and diagnosis of *C. hainanensis* was written by Li in 1953 using a specimen collected by Chun & Tso in Hainan Province of China (No. 44183). Hu (1964) considered *C. hainanensis* a synonym of *C. harringtonii*, but Hiệp & Vidal (1996) and Fu *et al.* (1999a) regarded *C. hainanensis* as a synonym of *C. mannii*. We do not accept the above treatments of Hu, Hiệp & Vidal and Fu *et al.* because the US holotype (Figure 21) is different from the holotypes of *C. harringtonii* (Figure 14) and *C. mannii* (Figure 17) in the morphological characteristics of their leaves, although characteristics of the holotype of *C. mannii* correspond well with those of the holotype of *C. harringtonii*. So we support retaining *C. hainanensis* as a distinct species and merge *C. mannii* into *C. harringtonii*. We also treated *C. harringtonii* var. *thailandensis* as a synonym of *C. hainanensis*, because the holotype of *C. harringtonii* var. *thailandensis* (Figure 22) matches the holotype of *C. hainanensis* (Figure 21) in all essential characters.



PHOTO 7. *Cephalotaxus hainanensis*.

Representative specimens:—CHINA. Guangxi: Gongcheng County, 2 December 1958, *Y. K. Li 402781* (IBK); Jinxiu Yao County, 30 June 1958, *Y. K. Li 400446* (IBK); Rong County, 10 June 1959, *Y. K. Li 404590* (IBK). Hainan: Ding' an County, 22 December 1933, *Z. Huang 35818* (IBK); Qiongzong Li and Miao County, 21 October 1956, *S. Q. Chen 10759* (PE). Tibet: Mêdog County, 18 July 1980, *Ecological Room 11163* (PE); Mêdog County, 8 August 1974, *Qinghai-Xizang Team 74-3076* (PE); Mêdog County, 26 November 1982, *B. S. Li & S. Z. Cheng 03138* (PE). Yunnan: Menghai County, 16 May 1981, *Anonymous 81-43* (PE); Jinghong County, 3 February 1951, *G. M. Feng 14483* (PE). VIETNAM. No locality, 8 January 1965, *Sino-Vietnam Exped. Team 1168* (PE). Gia Lai: Kontum Massif, elev. 1500 m, 21 December 1946, *M. Poilane 35983* (P). Lam Dong (Lâm Đồng): Massif, Lang Bian, Dran, elev. 1000–1200 m, 29 April 1919, *A. Chevalier 40374* (P); Plateau, Lang Bian, elev. 2000 m, 4 September 1901, *M. Jacquet 619* (P); Duc Trong,

Xa Heip An (Elephant Mountain), elev. 1300–1500 m, 11° 51' 02" N, 108° 26' 29" E, 7 September 2001, *M. F. Gardener et al.* 147 (E). Ben Tre (Bến Tre): La Lay et Tu Rut, elev. 500–600 m, 4 July 1927, *M. Poilane* 13543 (P). BURMA. Kachin: Khawbude, Hkinlum, North Trangle, elev. 4000–4500 ft, 9 August 1953, *F. Kingkon-Ward* 21252 (P). THAILAND. Chiang Mai: Doi Anga-Kette, elev. 1300–1650 m, 15 January 1905, *C. C. Hosseus* 342 (P).

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Appendix 1. The published taxa of *Cephalotaxus*

The published taxa of *Cephalotaxus* in chronological order (after Lang *et al.* 2011a with corrections)

No.	Year	Taxa—Original literature
1	1839	<i>Taxus harringtonii</i> Knight ex Forbes—Pinet. Woburn. 217. t. 66. 1839. [now is a basionym of <i>C. harringtonii</i> (Knight ex Forbes) Koch (1873)]. (<i>'harringtonia'</i>)
2	1842	<i>Cephalotaxus</i> Sieb. & Zucc. ex Endl.—Gen. Pl. Suppl. 2: 27. 1842.
3	1847	<i>C. pedunculata</i> Sieb. & Zucc. ex Endl.—Syn. Conif. 238. 1847 <i>nom. illeg.</i> .
4	1847	<i>C. drupacea</i> Sieb. & Zucc. ex Endl.—Syn. Conif. 239. 1847.
5	1847	<i>C. umbraculifera</i> Sieb. ex Endl.—Syn. Conif. 239. 1847. (▲)
6	1847	<i>C. tardiva</i> Sieb. ex Endl.—Syn. Conif. 239. 1847. (▲)
7	1850	<i>C. fortunei</i> Hook.—Bot. Mag. 76: t. 4499. 1850. (<i>'fortuni'</i>)
8	1855	<i>C. fortunei</i> Hook. var. <i>foemina</i> Hort. ex Carr.—Traité Conif. 509. 1855.
9	1856	<i>C. sumatrana</i> Miq.—Fl. Ned. Ind. ii. 1076. 1856. (▲)
10	1858	<i>C. kaempferi</i> Wieschof—Garten-Nachr. 1(11): 41. 1858.
11	1865	<i>C. pedunculata</i> Sieb. & Zucc. ex Endl. var. <i>fastigiata</i> Carr.—Prod. Fix. Var. Veget. 44. f. 1. 1865.
12	1867	<i>C. buergeri</i> Miq.—Ann. Mus. Bot. Lugduno-Batavi iii. 169. 1867.
13	1867	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. β <i>pedunculata</i> Miq.—Ann. Mus. Bot. Lugduno-Batavi iii. 169. 1867.
14	1873	<i>C. harringtonii</i> (Knight ex Forbes) Koch—Dendr. 2(2): 102. 1873.
15	1877	<i>C. coriacea</i> Hort. ex Lavallée—Énum. Arbres 295. 1877.
16	1877	<i>C. foemina</i> Hort. ex Lavallée—Énum. Arbres 295. 1877.
17	1884	<i>C. pedunculata</i> Sieb. & Zucc. ex Endl. var. <i>sphaeralis</i> Masters—in Gard. Chron. n. ser. 21. 113. figure 23. 1884.
18	1886	<i>C. mannii</i> Hook. f. —Hooker's Icon. Pl. 16: t. 1523. 1886.
19	1887	<i>C. pedunculata</i> Sieb. & Zucc. ex Endl. var. <i>sphaeralis</i> Masters—in J. Linn. Soc. Bot. 22: 203. pl. VII. 1887. [Republication of 1884 name with minor changes of text]
20	1888	<i>C. griffithii</i> Hook. f.—Fl. Brit. India. 5: 648. 1888.
21	1890	<i>C. griffithii</i> sensu Oliv. in Hooker's Icon. Pl. 20: t. 1933. 1890. non Hook. f. (1888).
22	1891	<i>C. koraiana</i> Hort. ex Beissn.—Handb. Nadelholzk. 181. 1891.
23	1897	<i>C. harringtonii</i> (Knight ex Forbes) Koch lus. <i>koraiana</i> K. Koch ex Ascherson & Graebner—Syn. Mitteleur. Fl. 1: 181. 1897.
24	1898	<i>C. oliveri</i> Masters—Bull. Herb. Boissier 6: 270. 1898.
25	1899	<i>C. fortunei</i> Hook. var. <i>concolor</i> Franch.—Jour. de Bot. 13: 265. 1899.
26	1900	<i>C. celebica</i> Warb.—Monsunia i. 194. 1900. (▲)
27	1901	<i>C. lanceolata</i> Hort. ex Beissn.—Mitt. Deutsch. Dendr. Ges. 10: 117. 1901.
28	1903	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>harringtonii</i> (Knight ex Forbes) Miq. in Pilger—in Engler, Pflanzenr. (Heft 18)IV.5: 102. 1903.
29	1903	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>harringtonii</i> (Knight ex Forb.) Miq. f. <i>sphaeralis</i> (Masters) Pilger—in Engler, Pflanzenr. (Heft 18)IV.5: 103. 1903.
30	1903	<i>C. argotaenia</i> (Hance) Pilger—in Engler, Pflanzenr. (Heft 18)IV.5: 104. 1903. (◆)
31	1903	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>harringtonii</i> (Knight ex Forb.) Miq. f. <i>fastigiata</i> (Carr.) Pilger—in Engler, Pflanzenr. (Heft 18)IV.5: 103. 1903.
32	1907	Cephalotaxaceae Neger—Die Nadelhölzer (Koniferen) und übrigen Gymnospermen. 23. 1907.
33	1913	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>fastigiata</i> Schneider—in Silva Tarouca, Uns. Freil.-Nadelh. 162. fig. 161. 1913.
34	1914	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>sinensis</i> Rehder & Wilson—in Sargent, Pl. Wilson. 2 (1): 3. 1914.
35	1914	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>sinensis</i> (Rehder & Wilson) f. <i>globosa</i> Rehder & Wilson.— in Sargent, Pl. Wilson. 2(1): 3. 1914.
36	1914	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>sphaeralis</i> (Masters) Rehder—in Bailey, Standard Cycl. Hort. II. 716. 1914.
37	1914	<i>C. wilsoniana</i> Hayata—Icon. Pl. Formosan. iv. 22. 1914.

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Appendix 1. (Continued)

No.	Year	Taxa—Original literature
38	1916	<i>C. lanceolata</i> Hort. ex Pilger—Mitt. Deutsch. Dendr. Ges. (25): 23. 1916.
39	1916	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>sphaeralis</i> (Masters) Pilger—Mitt. Deutsch. Dendr. Ges. (25): 22. 1916.
40	1919	<i>C. nana</i> Nakai—Bot. Mag. (Tokyo) 33: 193. 1919.
41	1919	<i>C. nana</i> Nakai var. <i>astringens</i> Nakai—Bot. Mag. (Tokyo) 33: 193. 1919.
42	1923	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>nana</i> (Nakai) Rehder—Jour. Arnold Arb. 4: 107. 1923.
43	1930	<i>C. koreana</i> Nakai—Bot. Mag. (Tokyo). 44: 508. 1930.
44	1930	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>drupacea</i> (Sieb. & Zucc. ex Endl.) Koidzumi—Bot. Mag. Tokyo 44: 98. 1930.
45	1930	<i>C. harringtonii</i> Knight ex Forbes var. <i>coraiana</i> (Sieb.) Koidzumi—Bot. Mag. (Tokyo). 44: 98. 1930.
46	1934	<i>C. drupacea</i> Sieb. & Zucc. ex Endl. var. <i>koreana</i> (Nakai) Hatus.—Exp. Forest. Kyushu Imp. Univ. 5: 38. 1934.
47	1941	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>nana</i> (Nakai) Rehder—Jour. Arnold Arb. 22: 569. 1941.
48	1941	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>koreana</i> (Nakai) Rehder—Jour. Arnold Arb. 22: 569. 1941.
49	1941	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>sinensis</i> (Rehd. & Wils.) Rehder—Jour. Arnold Arb. 22: 569. 1941.
50	1948	<i>C. fortunei</i> Hook. var. <i>longifolia</i> hort. ex Dallimore and Jackson—Handb. Conif. ed. 3. 42. 1948. (' <i>fortuni</i> ')
51	1948	<i>C. fortunei</i> Hook. var. <i>brevifolia</i> hort. ex Dallimore and Jackson—Handb. Conif. ed. 3. 42. 1948. (' <i>fortuni</i> ')
52	1949	<i>C. harringtonii</i> (Knight ex Forbes) Koch f. <i>fastigiata</i> (Carr.) Rehd.—Bibliogr. Cult. and Trees Shrubs. 5. 1949.
53	1953	<i>C. fortunei</i> Hook. var. <i>alpina</i> H. L. Li—Lloydia 16(3): 164. 1953.
54	1953	<i>C. hainanensis</i> H. L. Li—Lloydia 16: 164. 1953.
55	1953	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li—Lloydia 16: 162. 1953.
56	1953	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li f. <i>globosa</i> (Rehder & Jackson) H. L. Li—Lloydia 16: 163. 1953.
57	1964	<i>C. fortunei</i> Hook. var. <i>globosa</i> S. Y. Hu—Taiwania 10: 28. 1964.
58	1965	<i>C. harringtonii</i> (Knight ex Forbes) Koch cv. <i>Fastigiata</i> .—Flora of Japan, 111. 1965.
59	1974	<i>C. harringtonii</i> (Knight ex Forbes) Koch f. <i>drupacea</i> (Sieb. & Zucc. ex Endl.) Kitam.—Acta Phytotax. Geobot. 26(1–2): 9. 1974.
60	1974	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>wilsoniana</i> (Hayata) Kitam.—Acta Phytotax. Geobot. 26(1–2): 9. 1974.
61	1975	<i>C. lanceolata</i> K. M. Feng in Cheng <i>et al.</i> —Acta Phytotax. Sin. 13(4): 86. 1975.
62	1975	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li var. <i>latifolia</i> W. C. Cheng & L. K. Fu—Acta Phytotax. Sin. 13(4): 86. 1975. <i>nom. inval.</i>
63	1984	<i>C. alpina</i> (Li) L. K. Fu—Acta Phytotax. Sin. 22(4): 282. 1984.
64	1984	<i>C. latifolia</i> (Cheng & L. K. Fu) L. K. Fu—Acta Phytotax. Sin. 22(4): 280. 1984. <i>nom. inval.</i>
65	1984	<i>Cephalotaxus</i> Sieb. & Zucc. ex Endl. sect. <i>Pectinatae</i> L. K. Fu.—Acta Phytotax. Sin. 22(4): 279. 1984.
66	1984	<i>Cephalotaxus</i> Sieb. & Zucc. ex Endl. sect. <i>Cephalotaxus</i> L. K. Fu.—Acta Phytotax. Sin. 22 (4): 280. 1984.
67	1990	<i>C. fortunei</i> Hook. var. <i>lanceolata</i> (Feng) Silba—Phytologia 68(1): 27. 1990.
68	1997	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li var. <i>wilsoniana</i> (Hayata) L. K. Fu & Nan Li—Novon 7(3): 263. 1997.
69	1999	<i>C. latifolia</i> W. C. Cheng & L. K. Fu ex L. K. Fu & R. R. Mill—Novon 9(2): 185. 1999.
64	2000	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>latifolia</i> (W. C. Cheng & L. K. Fu) Silba—J. Int. Conifer Preserv. Soc. 7(1): 22. 2000.

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Appendix 1. (Continued)

No.	Year	Taxa—Original literature
70	2000	<i>C. harringtonii</i> (Knight ex Forbes) Koch var. <i>thailandensis</i> Silba—J. Int. Conifer Preserv. Soc. 7(1): 22. 2000.
71	2007	<i>C. fortunei</i> Hook. subsp. <i>alpina</i> (H. L. Li) Silba—J. Int. Conifer Preserv. Soc. 14(1): 4. 2007. (' <i>fortunei</i> ')
72	2007	<i>C. harringtonii</i> (Knight ex Forbes) Koch subsp. <i>drupacea</i> (Sieb. & Zucc. ex Endl.) Silba—J. Int. Conifer Preserv. Soc. 14(1): 7. 2007.
73	2007	<i>C. harringtonii</i> (Knight ex Forbes) Koch subsp. <i>hokkaidoensis</i> Silba—J. Int. Conifer Preserv. Soc. 14(1): 9. 2007.
74	2007	<i>C. harringtonii</i> (Knight ex Forbes) Koch subsp. <i>koreana</i> (Nakai) Silba—J. Int. Conifer Preserv. Soc. 14(1): 8. 2007.
75	2007	<i>C. mannii</i> Hook. f. subsp. <i>thailandensis</i> (Silba) Silba—J. Int. Conifer Preserv. Soc. 14(1): 13. 2007.
76	2007	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li subsp. <i>hainanensis</i> (H. L. Li) Silba—J. Int. Conifer Preserv. Soc. 14(1): 17. 2007.
77	2007	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li subsp. <i>latifolia</i> (L. K. Fu & R. R. Mill) Silba—J. Int. Conifer Preserv. Soc. 14(1): 16. 2007.
78	2007	<i>C. sinensis</i> (Rehder & Wilson) H. L. Li subsp. <i>wilsoniana</i> (Hayata) Silba—J. Int. Conifer Preserv. Soc. 14(1): 18. 2007.

In the table, underlined years indicates that taxa which were higher than the rank of species, named authors containing 'hort' or 'cv' indicates a cultivated original taxon. The taxa with '▲' have been combined with *Taxus* and the taxa with '◆' have been combined with *Amentotaxus*. Also, *C. pedunculata* Sieb. & Zucc. ex Endl. var. *fastigiata* Carr., *C. buergeri* Miq., and *C. harringtonii* (Knight ex Forbes) Koch f. *fastigiata* (Carr.) Rehd. were considered synonyms of *C. harringtonii* (Knight ex Forbes) Koch cv. 'Fastigiata' (Ohwi 1965).