A REASSESSMENT OF *PINUS* SUBGEN. *PINUS* IN CHINA

DE-ZHU LI*

A recent study of *Pinus* subgen. *Pinus* for the *Flora of China* project recognized 10 native species with four new combinations, all at subspecies rank, and determined one new homonym, and six new synonyms. A neotype is designated for *P. kesiya*. Doubtful or little-known species are listed.

Keywords. New combinations, new synonyms, *Pinus* subsect. *sylvestres*, taxonomy.

INTRODUCTION

As the largest genus of the gymnosperms, *Pinus* is one of the most important genera of trees in both natural and man-made vegetation in China. An earlier taxonomic account for the Chinese pines was written by Cheng (1930), who recognized nine species. This was followed by Wu's (1956) revision of 19 species. Further work was published in the Chinese version of the gymnosperm volume of the *Flora Reipublicae Popularis Sinicae* (Cheng & Fu, 1978) in which 24 native and 15 introduced species were treated. There has been no comprehensive treatment for the genus since then.

The concept of species is a problem still unresolved in biology. There are two main classes of species definition: taxonomic and biological (Davis & Heywood, 1963). One of the main differences between them is whether or not to use the criterion of reproductive isolation. In the case of *Pinus*, as pointed out by Stebbins (1950) and many others, the barriers of incompatibility and hybrid sterility are weakly developed, and most closely related species are separated largely by ecological and seasonal isolation. It is very difficult to define 'biological' species in the genus and this is not the goal of the present paper. However, species delimitation of Chinese pines using morphological-geographical methods has not been resolved. This is perhaps not surprising, especially in the subgenus *Pinus*, or the hard pines, with which this paper is concerned: all the species of this subgenus in China belong to the same subsection, *Sylvestres* (for infrageneric division, see Little & Critchfield, 1969) and therefore are closely related, except *P. roxburghii* in Tibet (sect. *Sula*, subsect. *Canarienses*). An attempt was made to reclassify the hard pines in China by consistently employing the same criteria for a given taxonomic rank. In addition, the rank of subspecies (rather than variety) has been used where patterns of geographical variation are apparent from the examination of numerous available specimens. For a discussion of infraspecific categories, see Hamilton & Reichard (1992).

As a result of the present study, 10 native species are recognized in subgen. *Pinus*

* Kunming Institute of Botany, Academia Sinica, Kunming, Yunnan 650204, China.

in the *Flora of China*. Additionally, *P. taeda* of N America and *P. thunbergiana* of Japan, which are naturalized in China, are also included. Descriptions, distribution and ecology of species, subspecies or varieties will be available in the English and updated version of the *Flora*. For practical reasons, new taxa published after June 1994 are not included for discussion.

Key to species of Pinus *subgen.* Pinus *in China*

1a. Seed-wing not detachable, falling together with seed body; apophyses strongly projected, claw-like; seed cones large, 9–15 × 4–7cm ——— **1. P. roxburghii**

1b. Seed-wing detachable, easily separating from seed; apophyses thickened or flat, but never claw-like; seed cones moderate-sized or small, usually less than 9cm long ——— 2

2a. Leaves in fascicles of 3 (sometimes mixed with fascicles of 2); scale leaf bases persistent on first- and second-year shoots ——— 3

2b. Leaves in fascicles of 2; scale leaf bases usually deciduous on first- and second-year shoots ——— 6

3a. Seed cones conspicuously armed; resin canals 2, medial; leaves long and thick, 12–25cm × 1–1.5mm (introduced N American species) — **12. P. taeda**

3b. Seed cones unarmed or weakly armed; resin canals 2–6, marginal or medial; leaves either long and thin or short and rigid (native, SW China) ——— 4

4a. Leaves in fascicles of 2 (with some of 3), short and rigid, 8–14cm × 1–1.5mm; apophyses strongly prominent, usually 4–6mm thick ——— **8. P. densata**

4b. Leaves usually in fascicles of 3, long and soft, 10–22(–27)cm × 0.5–1mm; apophyses thickened, usually 2–3mm thick ——— 5

5a. Leaves relatively thick, 0.7–1mm diam.; branches more or less drooping, first-year shoots uninodal, relatively stout, shiny reddish brown ——— **9. P. yunnanensis**

5b. Leaves slender, 0.5–0.8mm diam.; branches horizontally spreading, first-year shoots bi- or multinodal, slender, shiny yellowish brown or pale brown ——— **10. P. kesiya**

6a. Winter buds whitish; leaves rigid, not twisted or nearly so, 7–12cm × 1–1.3mm; resin canals 6–11, medial (introduced Japanese species) ——— **4. P. thunbergiana**

6b. Winter buds reddish brown to dull brown; leaves rigid or soft, more or less twisted; resin canals medial or marginal (native) ——— 7

7a. Leaves long, slender, mostly (12–)15–25cm × 0.6–0.8mm; umbos unarmed ——— 8

7b. Leaves short, thick, mostly (3–)7–12cm × 1–2mm; umbos armed or mucronate ——— 9

8a. Seed cones sessile or nearly so, narrowly ovoid before opening; apophyses flat, 1–2mm thick; resin canals 4–8, marginal ——— **5. P. massoniana**
8b. Seed cones with conspicuous peduncles, cylindrical before opening; apophyses prominent, 3–4mm thick; resin canals 2, medial — **11. P. merkusii**

9a. Leaves 3–9(–12)cm long; winter buds more or less resinous; young cones usually pendulous; apophyses prominent ——— **2. P. sylvestris**
9b. Leaves(5–)8–14cm long; winter buds non-resinous; young cones usually erect or pendulous; apophyses fat or thickened ——— 10

10a. Apophyses strongly prominent, 3–5(–8)mm thick; resin canals 5–9, marginal ——— **7. P. tabuliformis**
10b. Apophyses relatively flat, 2mm thick; resin canals medial or marginal —— 11

11a. Bark reddish brown to orange on lower portion of trunk; shoots pale yellow or reddish yellow; resin canals 4–6, marginal ——— **3. P. densiflora**
11b. Bark greyish brown to dull grey; first year shoots pale brown to brown; resin canals 3–4(–8), medial or with some marginal ——— **6. P. luchuensis**

1. Pinus roxburghii Sarg., Silva 11: 9 (1897). Type: not designated.

Previously this species was recorded only in the monsoon belt of the Himalayas from Bhutan to Pakistan (Critchfield & Little, 1966; Farjon, 1984). It was found distributed in Gyirong in south Xizang (Tibet) and was classified as a rare species in China (Fu & Jin, 1992).

2. Pinus sylvestris L., Sp. Pl. 2: 1000 (1753). Lectotype: illustration of 'Pinus sylvestris' in Dalechamps, Hist. General. Pl.: 45. ic.1586 (chosen by Farjon & Jarvis in Jarvis et al., 1993).
Syn.: *Pinus sylvestris* var. *mongolica* Litv. in Sched. Herb. Fl. Ross. 5: 160 (1905). Type: 'Mandshuria occidentalis (Mongolia), In arenosis pr. stat. viar ferreae Charchonte', *D. Litvinov* s.n. (holo. LE, n.v.).
Misident.: *Pinus sylvestris* var. *fastigiata* auct.: Q.F. An & X.X. Zhang in Bull. Bot. Res. Harbin 6(2): 147 (1986), non Carrière (1856).

Additional specimens examined. CHINA. Liaoning: Lushun, *Yuo-Chang Zhu* 837 (KUN). Heilongjiang: Manpi, *Yuo-Chang Zhu* 56 (KUN); Mijiang, Xiao Xingkaihu, *Guang-Zheng Wang* 777 (KUN). Inner Mongolia: Haila'er, *Z. Wang* 524 (KUN).

Pinus sylvestris (Scots pine) is the most widely distributed pine species; it grows throughout northern Eurasia, from Scotland and Spain in the west, to NE China (Critchfield & Little, 1966). The morphology of the Scots pine is very variable; more than 150 variants have been described. There have been different opinions on the taxonomic status of its populations in NE China. Until recently, Cheng & Fu (1978) treated these as var. *mongolica* while Kitagawa (1979) accepted only var. *sylvestris*. Some botanists (Chang & Li, 1982; An & Zhang, 1986) recognized both var. *mongolica* and var. *sylvestris* in China. By matching herbarium material throughout the

distribution range, it seems that the variation of this species in NE China also follows a clinal pattern, as it does in Europe and the Far East. To make the *Flora* compatible with other modern floras, such as *Flora Europaea* (Tutin, Burges, Chater et al., 1993) and the Russian checklist (Czerepanov, 1995), var. *mongolica* is not recognized here. Further study is needed to clarify the affinity of the Chinese populations of this species.

3. Pinus densiflora Siebold & Zucc., Fl. Jap. 2: 22 (1842). Type: Lectotype: 'in Japonia', *P.F. von Siebold* comm. 1842 ex herb. Zuccarini No. 438 (M; selected by Farjon, 1993).
Syn.: *Pinus densiflora* f. *sylvestriformis* Taken. in J. Jap. Forest. Soc. 24: 120 (1942); *Pinus sylvestris* var. *sylvestriformis* (Taken.) Cheng & C.D. Chu in Fl. Reipubl. Pop. Sin. 7: 246 (1978); *Pinus densiflora* var. *sylvestriformis* (Taken.) Q.L. Wang, Changbai Shan zhi-wu min-lu [Checklist of plants in Changbai Mt.] 49 (1982) & in Fl. Liaoningica I: 152 (1988). Type: not designated.

Additional specimens examined. CHINA. Heilongjiang: Xinkaihu, *Guang-Zheng Wang* 4076 (KUN). Liaoning: Fengcheng, *Yuo-Chang Zhu* 264 (KUN); Xiongyue, *Y.L. Chou* 2641 (KUN). Jiangshu: Lianyungang, Yuntai Shan, *S.L. Liou & K. Yao* 8510 (MO). Shandong (Shantung): *S.T. Dunn* 1394 (K); Lao Shan, *C.Y. Chiao* 3852 (K); Kunlunshan, *Shandong Exped.* 0432 (KUN); Weihaiwei, Peishan, *F.Y. Hwang* 453 (K); Taishan, *Shandong Univ.* 127 (KUN).

Morphological study (Wang, 1988) and molecular analysis (Szmidt & Wang, 1993) indicate that var. *sylvestriformis* is closer to *P. densiflora* than to *P. sylvestris*.

4. Pinus thunbergiana Franco in Anais Inst. Super. Agron. 16: 130 (1949).
Basionym: *Pinus thunbergii* Parl. in A.DC., Prodr. 16(2): 388 (1868) non Lamb., Descr. Pinus 2: v (1824). Type: not designated.

Additional specimens examined. CHINA. Inner Mongolia (?): Wang Yeh Fu, *R.C. Ching* 33 (E). Jiangsu: Yi-xing, *W.Z. Fang* 8059 (MO); Nanking, *collector unknown* s.n. (herb. no. 993) (E).

Pinus thunbergiana is naturally distributed in the coastal areas of Japan and southern Korea. It was introduced into China in the early 1900s and is now widely cultivated in Liaoning, Shandong and Zhejiang provinces as a reafforestation tree. It is also planted in Dalian, Hanzhou, Lushan, Nanjing, Wuhan, Shanghai and other major coastal cities as an ornamental tree.

In the literature, *Pinus thunbergii* Parl. was commonly used, but it is a later homonym of *P. thunbergii* Lamb.

5. Pinus massoniana Lamb., Descr. Gen. Pinus 1: 17 (1803). Type: [S Africa, Cape of Good Hope] a specimen 'brought by Mrt Francis Masson from the Cape of Good Hope, where it was raised from seeds which had been sent from China' (whereabouts unknown). Lectotype: Lambert, Descr. Pinus 1: t.12 (1803) (selected by Farjon, 1993).

Syn.: *Pinus crassicorticea* Y.C. Zhong & K.X. Huang in Guihaia 10: 287 (1990), **syn. nov.** Type: Guangxi, Leyu Xian, Yachang, alt. 910m, *Huang Kai-xiang* 63420 (IBK).

Additional specimens examined. CHINA. Fujian: *H.H. Chung* 2956 (E, K); *W.R. Charles* 740 (E, K). Guangdong: Guangzhou, *W.M. Chun* 5490 (K); *Dalziel* s.n. (E); *Freeman* 2404 (K); *A.D. Hancock* 76 (K); *Levine* 3368 (E), s.n. (Canton Christian College No. 428) (MO); Lantau Island, *F.A. McClure* 13091, 13092, 13109 (MO), 13194 (K); *F.W. Xing et al.* 190 (E); Luyuan, *C. Wang* 44089 (MO); Meihsien, *J.L. Gressitt* 1207 (E, MO); Waiyueng (Huiyang), *W.T. Tsang* 16618 (MO), 20021 (K, MO), 26096 (E); *Y. Tsiang* 15, 80 (E); *Kang Peng, W.T. Tsang & U.K. Tsang* 12043 (E); Yangjiang, *C. Wang* 41817 (IBSC, MO). Guangxi: *P.P. Wan & K.S. Chow* 79157 (E). Guizhou: Jiangkou (Kiangkow), *Y. Tsiang* 5438 (E), 7511 (K); Guiding (Pingfa), *J. Cavalerie* 1695 (K). Hubei: Yichang (Ichang), *A. Henry* 1212, 3275 (K); *H.C. Chow* 74 (E); *C. Silvestri* 3979 (E); *E.H. Wilson* 293, 793 (K), 1378 (E, K), 1469 (E, K), 1473 (E), 1744 (K), 1480 (E, K), 1481 (E, K), 1482 (K), 1802 (E), 2503 (E, K, MO); *1980 Sino-American Expedition* 1729 (E). Hong Kong: *Bodinier* 1421 (E); *Champion* 173, 174 (K); *Rev. Pere Faurie* 15844 (K); *Hind* 1841 (K); *R.V. Hoffman* s.n. (MO); *C.N. Page* 10333 (E); *G.R. Shaw* s.n. (MO); *Urgukart* 1861 (K); *E.H. Wilson* 1483 (E); *C. Wright* 471 (K). Hunan: *Handel-Mazzetti* 11582 (E). Jiangsu: Nanjing, *Chen & Teng* 4037 (E, K); Purple Mt., *A.N. Steward* 1906 (K), 1973 (E); *d'Argy* s.n. (E) (syntype of *Pinus argyi* Lemée & Lév.); *d'Argy* s.n. (bis) (E) (syntype of *P. argyi* Lemée & Lév.); *d'Argy* s.n. (E) (type of *P. argyi* var. *longevaginans* Lév.); Yixing (I-hing), *W.Z. Fang* 8062 (MO). Jiangxi: *H.C. Cheo* 490 (E, K). Sichuan: Chengkou, *R.P. Farges* s.n. (K No. 4688); *E.H. Wilson* 1468, 1476 (E, K); Ba Xian (Pahsien), *W.P. Fang* 47 (E, K), 3398, 6042 (E), *W.K. Hu* 7748 (E); Hubei-Sichuan boundary, Metasequoia area, *W.C. Cheng & C.T. Hua* 439, 655, 852, 1167, 1178 (all K); Yongchuan, *D.H. Du* 153 (MO, PE). Taiwan: *W.R. Price* 341, 714 (K); *C.C. Wang* 1254 (E, HAST); Taichung, *T.I. Chuang & M.T. Kao* 2625 (MO); *Y.P. Yang* 051219 (MO); Taihoku, *E.H. Wilson* 10136, 10229 (K). Yunnan: *J.S. Yong* 3148 (KUN); Funing, *H.T. Tsai* 58-9083 (KUN); Xijiang, *collector unknown* 73-211 (KUN); Zhejiang: *S. Chen* 963 (E, K), *W.B. (Brown?)* s.n. (E); Chibun Shan, *F.N. Meyer* 1458 (K).

Pinus crassicorticea was based on two specimens from northern Guangxi, the western boundary of *P. massoniana*, with slightly thicker needles (0.7–0.8mm diam. in the former vs. 0.6–0.8mm in the latter) and thicker bark (up to 10cm). It was described that in *P. crassicorticea* the first-year shoots bear with two or three nodes. However, this can sometimes be found in the southern part of the range of *P. massoniana* in Guangdong, especially in dry areas (Cheng & Fu, 1978). It was also stated that there was an internal resin canal in the needles of *P. crassicorticea*. This is a somewhat variable character. However, a re-examination of the type showed that the resin canals are all marginal.

6a. Pinus luchuensis H. Mayr subsp. **hwangshanensis** (Hsia) D.Z. Li, **comb. et stat. nov.** Basionym: *Pinus hwangshanensis* Hsia in Chin. J. Bot. 1: 17 (1936). *Pinus luchuensis* var. *hwangshanensis* (Hsia) C.L. Wu in Acta Phytotax. Sin. 5(3): 158 (1956). Type: Anhui, Huangshan, alt. 2000m, *M. Chen* 1252 (holo. PE).
Syn.: *Pinus hwangshanensis* Hsia ex Tsoong in Contr. Inst. Bot. Natl. Acad. Peiping 4(2–3): 156 (1936), nom. illeg. Type: Anhui, Huangshan, Xihaimen, alt. 1700m, *Liou & Tsoong* (PE, not found), **homonym nov.**

Pinus taiwanensis Hayata var. *damingshanensis* Cheng & L.K. Fu in Acta Phytotax. Sin. 13(4): 85 (1975), **syn. nov.** Type: Guangxi, Wuming, Damingshan, alt. 1100–1300m, Damingshan Exped. 74297 (PE, not found).

Additional specimens examined. CHINA. Anhui: Huangshan, *R.C. Ching* 3009 (E, K), 3028 (E), 3038 (K). Fujian: *C. Ho* 2255 (KUN); Guizhou: Fanjingshan, *collector unknown* 909 (KUN); Hunan: Xinning, *Lin-Han Liu* 15297 (KUN); Jiangxi: Anfu, Wugongshan, *Jun-San Yue* 3579 (KUN); Lushan, *L. Charter* 219 (E); *A.N. Steward* 2723 (MO); *E.H. Wilson* 1745, 1747 (E); *Yue-Guo Xiong* 6680 (KUN); Mingyueshan, *Jun-San Yue* 1461 (KUN); Shangyou, *Min-Xiang Ni* 08308 (KUN); Zhejiang: *R.C. Ching* 1545, 1607, 3299 (E, K), Tiantaishan, *S. Chen* 471 (E, K), 1244 (K); Feng Yang Shan, *H.Y. Zou* 279 (MO).

6b. Pinus luchuensis H. Mayr subsp. **taiwanensis** (Hayata) D.Z. Li, **comb. et stat. nov.** Basionym: *Pinus taiwanensis* Hayata in J. Coll. Sci. Imp. Univ. Tokyo 30: 307 (1911). Syntypes: Taiwan, Central Range, *T. Kawakami & U. Mori* 2097 (TI); Randaizan, *B. Hayata & U. Mori* 7142 (TI).

Additional specimens examined. CHINA. Taiwan: Arisan, *E.H. Wilson* 9788 (K); Chiayi Hsien, *T.I. Chuang & M.T. Kao* 4048 (MO); *C.C. Chuang* 2950 (MO); Hsingchu Hsien, *C.L. Huang* 64 (MO); Mt. Hohuan, *C.N. Page* 10103 (E); Hwalien Hsien, *C.C. Chuang & M.T. Kao* 4382 (MO); Nantou, Yushan, *Tamura, Shimizu & M.T. Kao* 22083 (E); Nantou, *M.H. Chen* 34 (MO); *E.H. Wilson* 9810, 9911, 11167 (K); Pinan, *E.H. Wilson* 11135 (K); Taichung, *H. Koyama* 24045 (E), *T. Shimizu & C.C. Chung* 20205 (E).

Pinus luchuensis, *P. taiwanensis* and *P. hwangshanensis* were described from the Ryukyu Islands, Taiwan and mainland China respectively. There has been no consensus on their inter-relationships for a considerable time. Wu (1956) accepted *P. hwangshanensis* as a variety of *P. luchuensis*, and *P. taiwanensis* as a synonym of the latter. However, Cheng et al. (1975) and Cheng & Fu (1978) treated *P. hwangshanensis* as a synonym of *P. taiwanensis*, and populations of *P. hwangshanensis* in Guangxi with both marginal and medial resin canals were recognized as a new variety of *P. taiwanensis*, var. *damingshanensis*. Among non-Chinese authors, Critchfield & Little (1966) accepted all three species, while Farjon (1984) did not mention *P. hwangshanensis*. Silba (1984) at first recognized only one species, *P. luchuensis*, but later (Silba, 1986) treated the other two taxa as varieties of the latter (even though his combination, *P. luchuensis* var. *taiwanensis* was not validated). It is true that the three taxa are similar to one another because of their seed cones, medial resin canals and relatively thicker needles. There are differences, though not very conspicuous, which make them distinct (Table 1). It is therefore better to treat them as one species with three subspecies.

There is an ambiguity in citing the authorship of *Pinus hwangshanensis*. Tsoong's paper is available in most western institutions, so that the compiler of *Index Kewensis* attributed the name to Tsoong. In fact, Hsia is the author of this name and she did publish a separate paper with exactly the same description but a different type citation. Both Tsoong and Hsia's papers appeared in 1936, but Hsia's was in the first issue of the *Chinese Journal of Botany* and presumed earlier than Tsoong's. Farjon (1993) reached the same conclusion but he ignored there was a specimen cited.

TABLE 1. Comparison of the subspecies of *Pinus luchuensis*.

	subsp. *luchuensis*	subsp. *taiwanensis*	subsp. *hwangshanensis*
Length of needles	12–16cm	8–11(–15)cm	5–10cm
No. of resin canals	2–3	6–7	3(–8)
Maximum height	20m	35m	25m
Distribution	Ryukyu Is.	Taiwan Is.	Mainland China
Altitude	0–850m	750–2500m	600–2000m

The only character to separate *Pinus taiwanensis* var. *damingshanensis* was leaves with both marginal and medial resin canals, but this character is not very reliable.

7. Pinus tabuliformis Carrière, Traité Conif. ed. 2: 510 (1867). Type: not designated.

7a. var. **tabuliformis**
Syn.: *Pinus mukdensis* Nakai in Bot. Mag. Tokyo 33: 195 (1919); *P. tabuliformis* var. *mukdensis* (Nakai) Uyeki in J. Chosen Nat. Hist. Soc. 3: 35 (1925), **syn. nov.** Type: Manchuria, Mukden (Liaoning, Shenyang), *H. Ueki* 2350 (TI).

Additional specimens examined. CHINA. Gansu: *J.F. Rock* 12538 (E, K). Hebei: (Chihli prov.) *M.S. Clemens* 6046, 6046a (E); Chende, *L. Charter* 195 (E); *P.S. Green* 2172 (K). Manchuria (Liaoning): *E.H. Wilson* 8815 (K). Ninghsia: Front of Ala Mt., *Y.Y. Pai* 183 (K). Peking (Beijing): *Bretchneid* 706 (K); *Limpricht* s.n. (K); *J.C. Liu* 314 (K). Shanxi: Taihangshan, *Yao* 2901 (Type of *P. taihangshanensis*, PE); Chin-ssü, *H. Smith* 7592 (E); Wu Chai Hsien, *J. Hers* 2045 (K). Shenxi (Shaanxi), Sa Hua Shan, *F.N. Meyer* 1828 (K).

P. mukdensis was said to differ from *P. tabuliformis* in having dark grey bark and greyish brown or dark grey twigs. However, such characters are also found in various populations of *P. tabuliformis*.

7b. var. **henryi** (Mast.) C.T. Kuan, Fl. Sichuanica 2: 113 (1983).
Basionym: *Pinus henryi* Mast., J. Linn. Soc., Bot. 26: 550 (1902); *Pinus massoniana* Lamb. var. *henryi* (Mast.) C.L. Wu in Acta Phytotax. Sin. 5(3): 153 (1956). Lectotype: Hubei (Hupeh), Fang Xian, *A. Henry* 6909 (K, selected here; excl. 42, Fang Shan, 15 iv 1876, Pinus Prov. Shui King, N, China, Comm. Mr. John Ross 10/77).
Syn.: *Pinus massoniana* Lamb. var. *wulingensis* C.J. Qi & Q.Z. Lin in Bull. Bot. Res. Harbin 8(3): 143 (1988), **syn. nov.** Type: Hunan, Cili Xian, Suoxiyu, *Peng Chun-Liang* 120357 (CSFC).

Additional specimens examined. CHINA. Hubei: Western Hubei (Hupeh), *E.H. Wilson* 1447 (K), 1485, 1486, 1487, 1488, 1489, 1490, 1494, 1495, 1497, 1498 (all at E & K); Shennongjia, 1980 *Sino-American Expedition* 1466 (E, KUN, MO); Xingshan, *Ying Liu* 614 (KUN). Sichuan: Fengjie, *M.Y. Fang* 24204 (KUN).

The status of *Pinus henryi* has been uncertain as it is an endemic taxon distributed

in a remote area (Daba Shan) in central China. Wu (1956) suggested that its relationship was with *P. massoniana*. However, the needles are shorter and thicker in *P. henryi* than in *P. massoniana*. Furthermore, the apophyses of the seed scales are more prominent, and the bark is deeply furrowed into irregular squares in *P. henryi*. These characters suggest that this taxon is more closely related to *P. tabuliformis* than to *P. massoniana*. According to Kuan (1983), *P. henryi* and *P. tabuliformis* have naturally overlapping ranges in the Daba Shan area in Sichuan province. It is therefore more appropriate to treat it as a variety of the former.

P. massoniana var. *wulingensis* was described from Wuling Shan of the Daba Shan area. It differs from *P. massoniana* by having shorter needles (5–7cm long) and smaller seed cones (3–3.5 × 2–3cm), and from *P. taiwanensis* by its leaves with marginal resin canals. However, the original authors failed to compare it with *P. henryi*, with which it is conspecific.

8. Pinus densata Mast. in J. Linn. Soc., Bot. 37: 416 (1906). Type: 'China occid., in silvis prope vallem Ya Lung ad. alt. 9000–11000 ped.', *E.H. Wilson* 3015 (holo. BM).

Additional specimens examined. CHINA. Sichuan: *W.C. Cheng* 805 (E), 1255, 1256 (K), 1775 (E, K), 1839 (E, K), 1840 (K), 2072 (E); *W.P. Fang* 3736 (E, K); *Handel-Mazzetti* 2290 (E); *C.R. Lancaster* L950, L1024 (K); *E.H. Wilson* 905 (E), 1397 (E), 1398 (E), 1493 (type of *P. wilsonii*) (A, E), 1465 (E, K), 1466 (E), 1467 (E), 1475 (E, K), 1478 (E), 1495 (E), 2500 (E, K), 2502 (E, K), 2504 (E, K), 3015 (K), 3016 (K) (type of *P. prominens*), 1055 (K), 4073 (E, K). Yunnan: NW Yunnan, *G. Forrest* 20115 (E); *T.T. Yu* 10725 (E); *Chungtien-Likiang-Dali Expedition* 481, 758 (E). Xizang (Tibet): SE Tibet, *Ludlow, Sheriff & Taylor* 1344 (MO), 4469 (E); Pome, *Ludlow, Sheriff & Taylor* 12028 (E).

Morphological study and molecular analysis suggested this is a hybrid of *P. yunnanensis* and *P. tabuliformis* (Wu, 1956; Wang & Szmidt, 1990). However, *P. densata* is still best treated as a species (for nomenclature see Note 1 of Art. H.3.4. of the ICBN).

9. Pinus yunnanensis Franch., J. Bot. (Morot) 13: 253 (1899). Type: Yunnan, Ta pin tze, *Delavay* 569 (holo. P, iso. K).

Syn.: *Pinus insularis* Endlicher var. *yunnanensis* (Franch.) Silba, Phytologia Mem. 7: 52 (1984).

Pinus yunnanensis var. *tenuifolia* Cheng & Law in Cheng et al. in Acta Phytotax. Sin. 13(4): 85 (1975), **syn. nov.**; *Pinus insularis* Endl. var. *tenuifolia* (Cheng & Law) Silba in Phytologia 68: 51 (1990). Type: Guizhou, Ceheng Xian, *Z.Y. Cao* 1038 (holo. PE).

Additional specimens examined. CHINA. Guizhou: *E. Bodinier* 938a (E), *Y. Tsiang* 7300 (E); Hezhang, *Ping-Hua Yu* 1324 (KUN); Xingyi, *Guizhou Exped.* 6110 (KUN). Sichuan: Western Sichuan, *E.H. Wilson* 1376 (E, K), 1393 (K), 1394 (E, K), 1395 (E, K), 1396 (E, K), 1399, 1464, 1471, 1472 (all E), *W.C. Cheng* 1726 (E), 1727 (K), 2986 (E); Kangding, *Z.J. Zhao* 113358, 113369 (E, K). Yunnan: NW Yunnan, *Ducloux* 813 (K); *G. Forrest* 7757, 9382, 17365, 19377, 20129, 23543, 23615 (all E); *Hand.-Mazz.* 8734 (K); *E.E. Maire* 2451 (E, K),

F. Kingdon Ward 216 (E); *T.T. Yu* 788, 8009, 19518, 22911 (E); *T.T. Yu* 8406, 20139 (KUN); Dali, *T.N. Liou* 20612 (KUN); *1981 Sino-British Expedition* 1043, 1176 (E, K), *1984 Sino-American Expedition* 1078 (E), *L. Charter* 191, 192, 206 (E); Jingdong, *M.K. Li* 338 (KUN); Kunming, *P.S. Green* 2187 (K); *K.D. Rushforth* 312 (E), *H.K. Teng* 496 (KUN); Lijiang, *T.T. Yu* 8075 (KUN). Xizang (Tibet): Yigong valley, *Bailey* s.n. (E); Zayu, *Xizang-Qinghai Exped.* 73-218 (KUN).

The delimitation of *P. yunnanensis* (Yunnan pine) is sometimes questionable because of its close relationships with *P. kesiya* and *P. insularis* (Wu, 1956; Silba, 1984). However, *P. yunnanensis* may be distinguished in having thicker leaves, more or less drooping branches, and uninodal and shiny reddish brown first-year shoots. The chemical constituents are also different (Mirov, 1967; Farjon, 1984).

Yunnan pine is basically restricted to the Yunnan plateau at elevations of 600–3000m. Two varieties were included in *Flora Reipublicae Popularis Sinicae*, var. *tenuifolia* in south-eastern Yunnan, western Guangxi and Guizhou, with thinner, longer and accordingly pendulous needles, and var. *pygmaea*, a shrub 0.4–2m tall with several trunks, distributed usually at higher elevations.

10. Pinus kesiya Royle ex Gordon in Loudon, Gard. Mag. 16: 8 (1840). Type: not designated. Neotype: India, Khasia, Regio Temp., alt. 2–6000ft, ('In Nepalia? in Khasya alt. 2–6000 ped. in regione temperata et tropica'), *J.D. Hooker & T. Thomson* s.n. (K, selected here; isoneo. E).

Syn.: *Pinus kasya* Royle ex Parl. in A.DC, Prodr. 16(2): 390 (1868). Type: India, Khasia, Regio Temp., alt. 2–6000ft, ('In Nepalia? in Khasya alt. 2–6000 ped. in regione temperata et tropica'), *J.D. Hooker & T. Thomson* s.n. (lecto. K, chosen here; isolecto. E).

Pinus khasya Royle ex Hook.f., Fl. Brit. Ind. 5: 652 (1888). Type: India, Khasia, Regio Temp., alt. 2–6000ft, ('In Nepalia? in Khasya alt. 2–6000 ped. in regione temperata et tropica'), *J.D. Hooker & T. Thomson* s.n. (lecto. K, chosen here; isolecto. E).

Pinus langbianensis A. Chev. in Rev. Int. Bot. Appl. Agric. Trop. 24: 25 (1944); *Pinus kesiya* A. Chev. var. *langbianensis* (A. Chev.) Gaussen ex Cheng & L.K. Fu, Fl. Reip. Pop. Sin. 7: 259. 1978, **syn. nov.** Type: Annam, Langbian, *Chevalier* 30024 (holo. P).

Additional specimens examined. CHINA. Yunnan: Baoshan, *Sheng-Tang Li* 80-315 (KUN); Jingdong, *collector unknown* L01438 (KUN); Jinghong (between Keng Hung and Muang Hing), *J.F. Lock* 2694 (E); Lincang, *Jing-San Xin* 527 (KUN); Mengla, *H.T. Tsai* 59-10709 (KUN); Mojiang, *Sino-Soviet Exped. to Yunnan* 8380 (KUN); Pu'er, *Sino-Soviet Exped. to Yunnan* 8356 (KUN); Simao, *H.T. Tsai* 80090 (KUN); Yanyang, *Hui-Xiang Li* 34 (KUN).

BURMA. Haka Chin, *F.G. Dickason* 7393 (E); Kampelet, Mt. Victoria, *R.E. Cooper* 5973 (E), *F. Kingdon Ward* 3076 (E); Mandaylay, Maymyo, *Main* 6277 (E), *E. Toenander* 3045 (E); Mindat Sakan, Hilawng Ridge, *U Mg Gale* (2) 9146 (E); N. Shan State, Lashio, *G.C.B. Stirling* 26647 (E); Pegu, *S. Kurz* 1003 (E).

INDIA. E Bengal: *Griffith* 4995 (K, MO).

THAILAND. Chieng-Mai, *C.C. Hossens* 318 (E, MO), *J.F. Maxwell* 89-141 (MO).

The nomenclature and taxonomy of the Khasia pine have a confused history. Firstly, *P. kesiya* Royle ex Gordon was sometimes regarded as a *nomen seminudum* (Wu, 1956). However, Gordon's protologue presented a sufficient diagnosis: 'the cones resemble those of *P. insignis*, but they are not near so large, much flatter, and the scale not so prominent'. Therefore, most authorities (Critchfield & Little, 1966; Styles & Burley, 1972; Laubenfels, 1988; Farjon, 1993) accept its validity.

Secondly, the Chinese populations, commonly called Simao pine in China, were named *P. kesiya* var. *langbianensis* (Cheng & Fu, 1978), typified by a specimen from central Vietnam. It was stated that the Simao pine and var. *langbianensis* differ from var. *kesiya* by having thinner bark, fissuring into irregular scaly plates. Field observations indicate that the bark of Simao pine may be as thick as 3cm. Further, examination of the type material of var. *langbianensis* and material from the Khasia mountains shows var. *langbianensis* should be part of the distribution of the Khasia pine.

Finally, with regard to its relationship with *P. insularis* Endl., the latter was usually merged with *P. kesiya* (e.g. Styles & Burley, 1972; Laubenfels, 1988), or for those who treated *P. kesiya* Gordon as a *nomen nudum*, *P. insularis* was used (Merrill, 1941; Wu, 1956; Silba, 1984). All herbarium specimens examined show that morphologically they are very similar in bearing longer and thinner needles in groups of three, fasciculate, multi-nodal first-year shoots and seed scales with prominent apophyses. It is therefore concluded that they are best considered conspecific. However, chemical differences may separate them (Farjon, 1984). In view of their geographical distribution, it seems more reasonable to accept two subspecies, subsp. *insularis*[1] from the Philippines and subsp. *kesiya* from China (southern Yunnan, south-eastern Tibet), Bangladesh, Bhutan, Burma, Cambodia, north-eastern India (Khasia), Laos, Nepal and Vietnam.

It is most likely that no herbarium specimen was preserved when Gordon published *P. kesiya*. It was 'raised from seeds presented to the Society by Dr. Royle, F. H. S.'. Therefore, a neotype is designated here, which is the same as that designated as lectotype for *P. kasya* Royle ex Parl. and *P. khasya* Royal ex J.D. Hooker, and the latter are made into two nomenclatural synonyms, to further the current usage of *P. kesiya*.

11. Pinus merkusii Jungh. & de Vriese subsp. **latteri** (Mason) D.Z. Li, **comb. et stat. nov.**

Basionym: *Pinus latteri* Mason in J. Asiat. Soc. Bengal 18(1): 74 (1849). Type: [Burma] 'In provincia Amherst: in convalli fluvii *Thoungyeen*', *Latter* (whereabouts unknown).

Syn.: *Pinus merkusiana* Cooling & Gaussen, Trav. Lab. Forest. Toulouse Tom. I, Vol. 8: 5 (1970), **nom. inval.** (Art. 37.1).

[1] **P. kesiya** subsp. **insularis** (Endl.) D.Z. Li, **comb. et stat. nov.**
Basionym: *Pinus insularis* Endl., Syn. Con. 157 (1847). Type: Philippines, Luzon, *Cumming* 956 (holo. K, iso. MO).

Pinus merkusii var. *latteri* (Mason) Silba in Phytologia 68: 53 (1990).

Pinus tonkinensis A. Chev. in Rev. Int. Bot. Appl. Agric. Trop. 24: 29 (1944). Syntypes: [Vietnam] Tonkin, Province de Laokay, Ta-phing, 1600m, d'alt. *Chevalier* 29 493 (P); Nord Annam: Province de Nghé-An (Vinh), réserve forestètr de Hoan-Mai, *Fleury* in Herb. Chevalier 30202 (P).

Additional specimens examined. BURMA. Magala Reserve, *J.H. Lace* 4720 (E); Tenasserim, Tavoy District, *J. Keenam, U Tun Aung & R.H. Rule* 1490, 1563 (E).

CHINA. Hainan: enroute to Wong Chuk, *Tung Ngai* 9805 (MO).

THAILAND. North Thailand, *T. Sorensen, K. Larsen & B. Hansen* 1729 (E).

According to Laubenfels (1988), the similar pines of mainland SE Asia and the Philippines differ from those of Sumatra noticeably by having a 'grass stage' for the seedling (after it emerges, the seedling grows for a season in height, then it grows without increasing in height in the second and third years). The needles of the mainland pines are 19–25cm long, and the seeds are nearly twice as heavy as those of the Sumatran ones. *P. merkusiana* Cooling & Gaussen was proposed to accommodate them, which, however, is a name published after 1958, without a designated type and thus not validly published (ICBN Art. 37.1). An earlier name, *P. latteri*, is already available. 'Grass stage', as a developmental feature, may not be a good character to separate species; this may partly explain why Laubenfels still treated *P. latteri* and *P. merkusiana* as synonyms of *P. merkusii*. However, in view of other morphological differences, such as longer needles and larger cones and seeds, as well as geographical distribution, *P. latteri* is here treated as a subspecies of *P. merkusii*.

12. P. taeda L., Sp. Pl. 2: 1000 (1753).

Lectotype: USA, *J. Clayton* 496 (BM; designated by Farjon & Jarvis in Jarvis et al. 1993).

Introduced to China 100 years ago. Cultivated as a reafforestation tree in Anhui, Fujian, Jiangsu, Jiangxi, Taiwan and Zhejiang.

DOUBTFUL NAMES

The following names are doubtful as there was not sufficient material available during this study.

1. *Pinus densiflora* Siebold & Zucc. var. *ussuriensis* Liou & Z. Wang in Liou, Illustr. Fl. Lign. Pl. NE China 548 (1955). Type: [Heilongjiang, Xingkaihu] 'China Boreali-Orientalis, lacus Chanka, in arenosis', *collector unknown* (IFP, n.v.). (?=*P. sylvestris*)

2. *Pinus ikedai* Yamamoto in Contr. Fl. Hainanensis 1: 20, t.1 (1943) (adopted from Chun, Fl. Hainan 1: 211, 1964). **Name not in Index Kewensis.** (?=*P. murkeri* subsp. *latteri*)

3. *Pinus massoniana* Lamb. var. *hainanensis* Cheng & L.K. Fu in Cheng et al. in Acta Phytotax. Sin. 13(4): 85 (1975). Type: Hainan, Bawang Ling, Yajia Daling, *C. Wang* 3117 (PE, not found). (?=*P. massoniana*)

4. *Pinus massoniana* Lamb. var. *shaxianensis* D.X. Zhou in Bull. Bot. Res. Harbin 11(3): 41 (1991). Type: Fujian, Sha Xian, *D.X. Zhou* 9016 (PE, not found). (?=*P. massoniana*)

5. *Pinus takahasii* Nakai in Bull. Forest. Soc. Korea 167: 32 (1939), p.p., quoad typicam. Type: [Heilongjiang] Sinkaihou (Xingkaihu), *Takahas* s.n. (TI, n.v.). (?= *P. sylvestris*)

ACKNOWLEDGEMENTS

The Royal Botanic Garden Edinburgh (Sibbald) Trust and the Ferguson Fellowship of the RBGE are gratefully acknowledged for financial support which made it possible for the author to carry out a year of postdoctoral research at the RBGE. This paper in part results from these studies. The Managing Centre of the Flora of China project at Missouri Botanical Garden and Cambridge University Botanic Garden are thanked for various support. My sincere thanks are due to Professor David Ingram, Drs Robert Mill, Mark Watson, Christopher Page and Kwiton Jong for assistance and encouragement, and to two anonymous reviewers for their frank comments on the manuscript. Last but not least, I am indebted to the Curators of the following herbaria for the loan of types or free use of facilities: A, IBK, K, KUN, MO, P, PE, SWFC and TI.

REFERENCES

AN, Q. F. & ZHANG, X. X. (1986). The little known *Pinus* from China. *Bull. Bot. Res. N.E. Forest. Inst.* 6(2): 147–149.

CHANG, H. F. & LI, M. X. (1982). Karyotype analysis of 'Mongolian pine' from north-eastern China. *Bull. Bot. Res. N.E. Forest. Inst.* 2(4): 123–130.

CHENG, W. C. (1930). A study of the Chinese pines. *Contr. Biol. Lab. Chin. Assoc. Advancem. Sci., Sect. Bot.* 6: 5–21.

CHENG, W. C., FU, L. K. & CHENG, C. Y. (1975). Gymnospermae Sinicae. *Acta Phytotax. Sin.* 13(4): 56–89. Pl. 1–66.

CHENG, W. C. & FU, L. K. (1978). (eds) Gymnospermae. In: *Flora Reipublicae Popularis Sinicae* Volume 7. Beijing: Science Press.

CRITCHFIELD, W. D. & LITTLE, E. L. JR (1966). Geographic distribution of the pines of the world. *US Dept. Agric. Forest Serv. Misc. Publ.* No. 991. Washington D.C.

CZEREPANOV, S. K. (1995). *Vascular plants of Russia and adjacent states (the former USSR).* Cambridge: Cambridge University Press.

DAVIS, P. H. & HEYWOOD, V. H. (1963). *Principles of Angiosperm Taxonomy.* Edinburgh: Oliver & Boyd.

FARJON, A. (1984). *Pines: drawings and descriptions of the genus* Pinus. Leiden: E. J. Brill & Dr W. Baxkhuys.

FARJON, A. (1993). Names in current use in the *Pinaceae* (Gymnospermae) in the ranks of genus to variety. NCU-2. *Regnum Veg.* 128: 107–146. Konigstein: Koeltz.

FU, L. K. & JIN, J. M. (eds) (1992). *China Plant Red Data Book: rare and endangered plants.* Beijing & New York: Science Press.

HAMILTON, C. W. & REICHARD, S. H. (1992). Current practice in the use of subspecies, variety and forma in the classification of wild plants. *Taxon* 41: 485–498.
JARVIS, C. E., BARRIE, F. R., ALLAN, D. M. & REVEAL, J. L. (1993). A list of Linnaean generic names and their types. *Regnum Veg.* 127. Konigstein: Koeltz.
KITAGAWA, M. (1979). *Neo-Lineamenta Florae Manshuricae.* Vaduz: A. R. Gantner.
KUAN, C. T. (ed.) (1983). *Flora Sichuanica.* Tomus 2 (Gymnospermae). Chengdu: Sichuan Science and Technology Press.
LAUBENFELS, D. J. DE (1988). Coniferales. In: *Flora Malesiana.* Ser. I. (Spermatophyta) 10(3): 337–453.
LITTLE, E. L. JR. & CRITCHFIELD, W. B. (1969). Subdivisions of the genus *Pinus* (pines). *US Dept. Agric. Forest Serv. Misc. Publ.* No. 1144. Washington D.C.
MERRILL, E. D. (1941). The Upper Burma plants collected by Captain F. Kingdon-Ward on the Vernary-Cutting expedition, 1938–39. *Brittonia* 4: 20–188.
MIROV, N. T. (1967). *The genus* Pinus. New York: The Ronald Press Company.
SILBA, J. (1984). An international census of the Coniferae. I. *Phytologia Memoirs* 7: 47–59.
SILBA, J. (1986). Encyclopaedia Coniferae. *Phytologia Memoirs* 8: 129–169.
STEBBINS, G. L. JR (1950). *Variation and Evolution in Plants.* New York: Columbia University Press.
STYLES, B. T. & BURLEY, J. (1972). The botanical name of the Khasi Pine (*Pinus kesiya* Royle ex Gordon). *Commonw. Forest. Rev.* 51(3), No. 149: 241–245.
SZMIDT, A. E. & WANG, X. R. (1993). Molecular systematics and genetic differentiation of *Pinus sylvestris* L. and *P. densiflora* Siebold. & Zucc. *Theor. Appl. Genet.* 86: 159–165.
TUTIN, T. G., BURGES, N. A., CHATER, A. O. et al. (1993). *Flora Europaea*, ed. 2. Cambridge: Cambridge University Press.
WANG, Q. L. (1988). Pinaceae. In: *Flora Liaoningica* 1: 128–160.
WANG, X. R. & SZMIDT, A. E. (1990). Evolutionary analysis of *Pinus densata*, a putative tertiary hybrid. 2. A study using species-specific chloroplast DNA markers. *Theor. Appl. Genet.* 80: 641–647.
WU, C. L. (1956). The taxonomic revision and phytogeographical study of Chinese pines. *Acta Phytotax. Sin.* 5(3): 131–162. Pl. 24–27.

Received 24 November 1995; accepted with major revision 9 January 1997