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Postprint: New Data on Yunnan Angiosperms

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Date: 2018-07-18T00:00:00+00:00

Abstract

Plant resource surveys are fundamental for investigating phylogeny, floristic evolutionary history, and phylogenetic relationships, and constitute one of the important tasks of botanical research in China. Although China has accumulated rich experience in plant resource surveys, as represented by the “Flora of China” and various local floras, data on plant resources in some remote areas remain lacking. Through comparative morphological analysis, three new records of angiosperms were discovered in Yunnan Province. *Actinodaphne lecomtei* Allen was originally distributed in Sichuan, Guizhou, Guangdong (Ruyuan), and Guangxi, with Qiubei County, Yunnan Province representing a new record locality; *Cinnamomum ilicioides* A.Chev. was originally distributed in Guangdong, Hainan, Guangxi, and northern Vietnam, with Mengla County, Xishuangbanna Dai Autonomous Prefecture, Yunnan Province representing a new record locality; *Carya kweichowensis* Kuang A.M.Lu ex Chang et Lu was originally distributed in Anlong, Wangmo, Ceheng, Xingyi, and other localities in Guizhou, with Qiubei County, Yunnan Province representing a new record locality. The new distribution localities of *Actinodaphne lecomtei* and *Cinnamomum ilicioides* in Yunnan supplement the weak zones of Lauraceae in China, providing new material for analyzing the origin and evolution of primitive Yunnan species in related genera and for taxonomic studies of Chinese Lauraceae; at the species level, *Carya kweichowensis* provides a new case for determining the relationship between *Carya kweichowensis* and *Annamocarya sinensis*, and offers germplasm resources for developing *C. cathayensis* production in Yunnan.

Full Text

Preamble

Figures 1 [Figure 1: see original paper] and 2 are half-column, 155 mm in height; Figure 3 [Figure 3: see original paper] is half-column, 85 mm in height.

New Data of Angiosperms in Yunnan

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Abstract

Survey on plant resources plays a fundamental role in studying plant systematics, floristic evolutionary history, and affinities, representing one of the important tasks of botanical research in China. Although China has accumulated rich experience in plant resources investigation, exemplified by *Flora of China* and various local floras, data on plant resources in some remote areas remain lacking. Through comparative morphological analysis, we discovered three new distribution records of angiosperms in Yunnan Province. *Actinodaphne lecomtei* Allen, previously known from Sichuan, Guizhou, Guangdong (Ruyuan), and Guangxi, is newly recorded from Qiubei County, Yunnan. *Cinnamomum ilicioides* A. Chev., originally distributed in Guangdong, Hainan, Guangxi, and northern Vietnam, is newly recorded from Mengla County, Xishuangbanna Dai Autonomous Prefecture, Yunnan. *Carya kweichowensis* Kuang A. M. Lu ex Chang et Lu, previously known from Anlong, Wangmo, Ceheng, and Xingyi in Guizhou, is newly recorded from Qiubei County, Yunnan. The new distribution records of *A. lecomtei* and *C. ilicioides* in Yunnan complement the understudied regions of Lauraceae in China, providing new materials for analyzing the origin of primitive Yunnan species in related genera and for taxonomic studies of Chinese Lauraceae. At the species level, the new distribution record of *C. kweichowensis* offers a novel case for determining the relationship between *C. kweichowensis* and *Annamocarya sinensis*, while also providing germplasm resources for developing *Carya cathayensis* production in Yunnan.

Keywords: *Actinodaphne lecomtei*, *Cinnamomum ilicioides*, *Carya kweichowensis*, biogeographic implications, Yunnan

Funding: Supported by Chinese Medicine Industry Research Program (201207002) and Chinese Medicine Program for the Public Health ([2011] No. 76).

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Introduction

Plant resource survey, collection, and classification represent traditional yet fundamental research disciplines that formally took shape in China during the 1920s. Nearly a century of intensive plant resource investigation and collection has yielded substantial achievements, including *Flora of China*, numerous local floras, and important monographs on floristic geography. These works have laid a solid foundation for plant taxonomic research, biodiversity conservation, and plant resource utilization both in China and worldwide (Yang and Liu, 2015). Overall, China's botanical research remains at the forefront globally; however, this represents only the beginning rather than the end. Clarifying plant species classification in China still requires extensive research, with supplementation and improvement of understudied taxa and regions representing important future tasks (Sun et al., 2017). In recent years, botanists across China have continuously reported new taxa, such as new plant records from Northeast China (Lu, 2002; Zheng et al., 2016), statistics on newly distributed species in Beijing (Liu and Zhang, 2014), reports on new angiosperm distributions in Inner Mongolia (Alatanzhula et al., 2018), and documentation of Hainan flora (Li et al., 2017). These data provide new materials for in-depth research on Chinese floristics and plant taxonomy.

During remeasurements of Xishuangbanna tropical rainforest permanent plots from 1994–2016 and the fourth national survey of traditional Chinese medicine resources in Qiubei County, Wenshan Zhuang Autonomous Prefecture (March 2015–September 2016), we identified three new distribution records of angiosperms in Yunnan through literature review and specimen identification. The newly recorded locations, Qiubei County and Mengla County, are situated in southeastern Yunnan within the transition zone between the Pan-Arctic and Paleotropical floristic regions (Wu, 2011) and represent a distribution center for Chinese endemic seed plant genera (Li, 1994). This special geographical location endows the newly recorded species with significance for exploring connections between Yunnan flora and adjacent regions, while providing materials for investigating fundamental theoretical questions regarding the origin of Yunnan flora and plant diversity. Voucher specimens of *Actinodaphne lecomtei* and *Carya kweichowensis* are deposited at the Herbarium of Traditional Chinese Medicine Resources Center, Chinese Academy of Chinese Medical Sciences; the Herbarium of Yunnan Branch, Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences (IMDY); and the Plant Herbarium of Forestry College, Southwest Forestry University. Voucher specimens of *Cinnamomum ilicoides* are deposited at the Plant Herbarium of Forestry College, Southwest Forestry University.

1. Study Area Overview

Yunnan Province is located in southwestern China (97.52°–106.18° E, 21.13°–29.25° N), bordering Tibet, Sichuan, Guizhou, and Guangxi in China, as well as Vietnam, Laos, and Myanmar. The terrain is high in the northwest and low in

the southeast, with diverse and complex landforms ranging in elevation from 76.4 to 6,740 m. Climate varies markedly with altitude, encompassing seven climate types: north tropical, south subtropical, central subtropical, north subtropical, warm temperate, mid temperate, and plateau climate. The province's mean temperature in the hottest month (July) ranges from 19 to 22 °C, while the coldest month (January) averages 6–8 °C or above, characterized by small annual temperature variation but large diurnal variation. The southern border region is frost-free year-round, while northwestern and northeastern Yunnan have frost-free periods of 210–220 days. Annual sunshine duration ranges from 1,000 to 2,800 hours. Precipitation is extremely unevenly distributed seasonally and geographically, ranging from 584 to 2,700 mm, with distinct wet (May–October) and dry (November–April) seasons.

2. Research Methods

We employed morphological comparison and identification methods. Representative branches, leaves, flowers, and fruits were collected from healthy plants in the field, fully dried, and prepared as herbarium specimens. Species were identified through morphological comparison with *Flora of China*, *Flora of Yunnan*, and type specimens.

3.1.1 *Actinodaphne* Nees

Actinodaphne lecomtei C. K. Allen

Main Characteristics: Evergreen tree; branchlet bases without persistent bud scales; leaves subverticillate or alternate, blade lanceolate to linear-lanceolate, 10–20 cm long, 1.5–3.0 cm wide, dark green above, gray-green and pale beneath, pinninerved, with numerous dense lateral veins (30–40 or more per side), slender and indistinct; inflorescences umbellate, without peduncles, tepals 6, anthers 4-locular; fruit obovoid, glabrous; fruiting receptacle cupular, entire or shallowly undulate (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1982; Flora of China Editorial Board, 2008; Li et al., 2006).

Morphologically, this specimen differs from *A. confertiflora* and *A. obovata* by its pinnate venation; from *A. obscurinervia* and *A. trichocarpa* by the absence of persistent bud scales at branchlet bases; and from *A. pilosa* and *A. henryi* by its numerous dense lateral veins (30–40 per side) that are slender and indistinct. It closely matches the type specimen of *A. lecomtei* (collected by F. T. Wang in 1931, collection number 23250). Flowers were not observed; only leaf, branch, and fruit characteristics were examined.

Voucher Specimen: 05 August 2016, Du Fan et al. 5326262417 (specimen number meaning: 532626 = Qiubei County code, 2417 = specimen number) (Fig. 1), collected from Yangxiongshan, Shede Township, Qiubei County (104°13 34.1 E, 23°59 13.4 N), in limestone evergreen broad-leaved forest at 2,459 m elevation—significantly higher than the 650–1,800 m described in *Flora of China*.

Distribution: Previously recorded from Sichuan, Guizhou, Guangdong (Ruyuan), and Guangxi (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1982; Flora of China Editorial Board, 2008; Li et al., 2016). This represents the first record for Yunnan.

Note: A. Specimen; B. Fruit; C. Plant.

Fig. 1 *Actinodaphne lecomtei*

3.1.2 *Cinnamomum* Trew

Cinnamomum illicioides A. Chevalier

Main Characteristics: Tree; crown spherical, bark brown with deep longitudinal fissures; leaves alternate, entire, subcoriaceous, ovate or ovate-oblong elliptic, pinninerved, with 3-5 lateral veins per side, conspicuous glandular pits often present in leaf axils beneath, petiole 1.3-2.0 cm; infructescences paniculate, fruit obovoid, fruiting receptacle campanulate (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1982; Flora of China Editorial Board, 2008).

The most distinctive feature separating this species from other *Cinnamomum* species is its strong star-anise fragrance, which explains the specific epithet “illicioides” meaning “resembling star-anise.” Interestingly, the Hani people of Xishuangbanna call this plant “man la a wei,” meaning “star-anise’ s uncle.” The local ethnic minority’ s nomenclature aligns remarkably well with the taxonomists’ naming of “illicioides.”

Voucher Specimen: Initially identified as Lauraceae based on bark fragrance in 1994. Due to the tree’ s height, complete specimens were not collected until 2016, when species identification was confirmed using *Flora of China*. Du Fan et al. 0824359 (08 = 8th large plot of Xishuangbanna tropical rainforest permanent sample plot, 24 = 24th subplot within the large plot, 359 = sequential number of advanced species appearing in the 50 m × 50 m large plot; this tree is number 359) (Fig. 2 [Figure 2: see original paper]), collected from Bubeng Village, Mengla County, Xishuangbanna Dai Autonomous Prefecture, in seasonal rainforest at 750-760 m elevation.

Distribution: Previously recorded from Guangdong, Hainan, Guangxi, and northern Vietnam (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1982; Flora of China Editorial Board, 2008). This represents the first record for Yunnan.

Fig. 2 *Cinnamomum illicioides*

3.2.1 *Carya* Nutt., nom. Conserve.

Carya kweichowensis Kuang A. M. Lu ex Chang et Lu

Main Characteristics: Tree; buds naked; pith solid, not separated into thin lamellae; leaves odd-pinnate, with 5 leaflets (3 larger upper leaflets and 2 smaller lower leaflets), papery, elliptic, oblong-elliptic, or oblong-lanceolate, apex obtuse to acute, base oblique, obtuse-rounded to cuneate, margin serrate, glabrous above, lateral veins 11–13 pairs, anastomosing near leaf margin; male catkins 1–3 per bundle; female spikes terminal, erect; fruit oblate, rarely oblate-obovoid, nut oblate-globose, apex depressed, base flat-rounded, with two longitudinal depressed lines (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1979; Deng, 1994; Flora of China Editorial Board, 1999; Ai et al., 2006).

Morphologically, this specimen differs from *C. illinoensis* by its naked buds and 5 leaflets (vs. scaly buds and 11–17 leaflets). It differs from *C. cathayensis*, *C. tonkinensis*, and *C. hunanensis* by its elliptic or oblong-elliptic leaflets with wavy serrate margins (vs. ovate-lanceolate leaflets with acute apex and finely serrate margins). It closely matches the type specimen of *C. kweichowensis* (collected by Zhang Zhisong and Zhang Yongtian in 1960, collection number 5460). Flowers and fruits were not observed.

Voucher Specimen: 07 June 2015, Du Fan et al. 5326260709, collected from Liangshan Village, Qiubei County (103°58 21.4 E, 23°53 40.7 N) (Fig. 3), in limestone evergreen broad-leaved forest at 1,728.5 m elevation—higher than the 1,300 m described in *Flora of China*.

Distribution: Previously recorded from Anlong, Wangmo, Ceheng, Xingyi, and other counties in Guizhou (Chinese Academy of Sciences Editorial Board of Flora Reipublicae Popularis Sinicae, 1979; Flora of China Editorial Board, 1999). This represents the first record for Yunnan.

Fig. 3 *Carya kweichowensis*

4.1 Biogeographic Significance of *Actinodaphne lecomtei* and *Cinnamomum illicioides* in Yunnan

Lauraceae is a major woody plant group (except for the herbaceous parasitic genus *Cassytha*), representing one of the basal lineages of angiosperms and among the most taxonomically challenging families in the group (Li and Li, 2004; Paton et al., 2008). The family plays a crucial role in tropical to subtropical forests of the Old World and moist forests of the New World, serving as a key dominant group in evergreen broad-leaved forests of these regions (Gentry, 1988). Its systematic evolution and origin have long attracted research attention. Li (1992) suggested that southeastern Yunnan may represent one of the origins or evolutionary centers of Lauraceae, and that Yunnan is floristically closely related to Sichuan, Tibet, Hainan, Guangdong, and Guangxi.

The discovery of *Alseodaphne rugosa* in Yunnan also confirmed floristic connections between Yunnan and Hainan (Mo et al., 2017). However, despite extensive research on Lauraceae systematics and taxonomy in China, gaps and urgent issues remain in certain taxonomic groups. Yang and Liu (2015) noted that Lauraceae surveys in border regions of Guangxi, Yunnan, and Tibet are weak, with many blank areas where new species and new records await discovery. *Actinodaphne lecomtei* was previously known from Sichuan, Guizhou, Guangdong (Ruyuan), and Guangxi, while *Cinnamomum illicioides* was known from Guangdong, Hainan, Guangxi, and northern Vietnam. Their discovery in Xishuangbanna and Qiubei County, Yunnan, precisely complements these understudied regions of Lauraceae in China, providing new materials for analyzing the relationship between primitive Yunnan species and related genera, as well as for taxonomic studies of Chinese Lauraceae.

4.2 Biogeographic Significance of *Carya kweichowensis* in Yunnan

Carya represents the most evolutionarily advanced genus in Juglandaceae, comprising the section *Apocarya* (naked buds) and section *Carya* (valvate bud scales). China has four native species, all belonging to section *Apocarya*, which is distributed mainly in India, Laos, Vietnam, and eastern China, and may represent its center of origin (Lu, 1982; Zhao, 1995; Grauke, 2012). Zhao (1995) also suggested that the genus *Annamocarya* may represent a branch diverged from *Carya* ancestors, and that the taxonomic relationship between *Annamocarya* and *Carya* remains controversial (Grauke, 2012). *Carya poilanei* possesses characteristics linking extant members of *Annamocarya* from the United States and Mexico with fossil *Carya* from Europe, but this species is only distributed in Vietnam and Laos and may already be extinct (Grauke, 2012). Deng (1994) considered *Carya kweichowensis* similar to *C. poilanei* in certain traits, both being anther-glabrous types, though their relationship requires molecular support. Geographically, *Annamocarya sinensis* is distributed in southern Guizhou, Guangxi, and southeastern Yunnan. The new distribution record of *Carya kweichowensis* in southeastern Yunnan increases the geographic overlap between the two species and provides a new case at the species level for determining their relationship. Currently, international focus centers on *Carya cathayensis* production, where geographic origin and chromosome number of populations affect rootstock and scion development (Grauke, 2012). Therefore, this new distribution also provides germplasm resources for developing *C. cathayensis* production in Yunnan.

Acknowledgments

We thank all staff involved in the fourth national survey of traditional Chinese medicine resources in Qiubei County and the Xishuangbanna tropical rainforest permanent plot monitoring, as well as Professors Xu Yuanjie and Zhang Yuxiao for their assistance in field surveys and manuscript preparation.

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