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## 羊蹄甲属的系统与生物地理学: 1. 厚盘组的分支分析

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**A 摘要** 羊蹄甲属厚盘组作为一个分类实体包含有约18个种, 本组植物主要分布于中国南部及中南半岛等地, 其中很多种类在其分布区内地理替代现象相当明显。对此组的分支系统学研究, 一方面有助于对本组种类系统进化关系的理解, 另一方面又为对热带亚热带亚洲大陆各区系之间关系的理解提供帮助, 为本地区的分支生物地理学研究提供材料。

本文用30个形态及叶脉脉序性状对厚盘组进行了分支分析, 云南羊蹄甲被选作外类群, 内类群包括龙须藤亚组及攀援羊蹄甲亚组的所有18个种, 分析产生了8个最简约的分支图, 分析还表明攀援羊蹄甲单独作为一个亚组是不可取的, 厚盘组的分类及生物地理学需要进一步的研究。

**关键词** 羊蹄甲属; 厚盘组; 分支分析

Systematics and biogeography of *Bauhinia* L.  
(Leguminosae-Caesalpinioideae): I. Cladistic analysis  
of sect. *Lasiobema* (Korth.) Benth.

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**Abstract** A cladistic analysis of sect. *Lasiobema* based on 30 morphological and leaf venational characters is presented. *Bauhinia yunnanensis* Franch. chosen as its out-group. All 18 species in subsect. *Scandentes* and subsect. *Championae* are included. Eight equally most parsimonious cladograms are produced. Some clades, the (*B. comosa*, *B. esquirolii*) clade, the (*B. scandens*, *B. delavayi*), (*B. flava*, (*B. oxysepala*, *B. penicilloba*)) clade, the (*B. concreta*, *B. curtissii*) clade, the (*B. harmsiana*, (*B. calycina*, *B. godfroyi*)) clade, are stable in all cladograms produced. The subsectional status of *B. scandens* is not warranted. Further studying is needed to make more detailed account on the systematics and biogeography of sect. *Lasiobema*.

**Key words** *Bauhinia*; sect. *Lasiobema*; cladistic analysis

### Introduction

*Lasiobema* as a taxonomic entity was first recognized by Korthals (1841). But he failed to design a status for it. Benth (1865) ranked it a section. De Wit (1956) recognized it as a genus in which the *Tubicalyx* species included.

*Lasiobema* as a section is maintained by Wunderlin, Larsen and Larsen (1987).

The section *Lasiobema* is a group mainly confined to the tropical continental Asia, the geological and biogeographical history of which is very complicated. Some authors even think that a part of Southeast Asia had Gondwanic origin (Audley-Charles, 1987). A better understanding of the biogeography of the areas concerned has to be based on a better understanding of the phylogenetic relationship of organisms occur in which.

Since the publication of Hennig's "Phylogenetic Systematics" in English in 1966, Cladistics (i. e., Farris, 1970; Nelson & Platnick, 1981; Wiley, 1981) has become a routine in elucidating the organismal relationship.

Organism and its physic environment evolve together (Croizat, 1958; 1964). Historical biogeography is to find patterns in organismal distribution and to elucidate hypothesis on the process that generated these patterns (Brooks, 1981, 1990; Nelson & Platnick, 1981; Humphries & Parenti, 1986; Zandee & Roos, 1987). In a cladistic biogeography analysis, cladograms of unrelated groups of organisms occurring in the area studied is needed if a general areagram is to be built. But no other group comparable to sect. *Lasiobema* in distributional pattern has been cladistically analysed yet. A cladistic analysis on *Lasiobema* is carried out to add to our knowledge of the evolution of this group in one hand, and in the other hand, as the first step in building a general areagram of the areas concerned.

In this study sect. *Lasiobema* includes subsections *Championae* and subsect. *Scandentes* as defined by Wunderlin et al. (1987). Subsect. *Pullae* is excluded from the section. subsect *Pullae* is more closely related to sect. *Tubicalyx* and set. *Loxocalyx* according to a cladistic analysis on the genus *Bauhinia* (Zhang, in prep.).

The species listed below are used as OTUs in this study.

*B. scandens* L.: Java, mainland Thailand, Vietnam, Laos, Cambodia, Hainan, Burma, India and Sri Lanka.

*B. apertilobata* Merr. & Metc.: China: Fujian, Jiangxi, Guangdong and Guangxi, on the Nanling Mountain Range.

*B. calycina* Pierre ex Gagn.: Cambodia: Kompong Speu.

*B. championii* (Benth.) Benth.: China: Hainan, Guangdong, Guangxi, Hunan, Hubei, Fujian, Taiwan, Jiangxi, Guizhou, Zhejiang; Vietnam: Lang Son, Quang Ninh, Ha Son Binh; India.

*B. comosa* Craib: China: Yunnan, Sichuan (Liangshan).

*B. concreta* Craib: Thailand: Peninsula.

*B. curtissii* Prain: Cambodia: Pursat. Laos: Savannakhet. Vietnam: Binh Tri

Thien, Phu Khanh, Thuan Hai,, Dong Nai. Malaysia: Malay Peninsula: Langkawi Is.; Thailand.

*B. delavayi* Franch.: China: Yunnan (Binchuan, Luchuan, Fengqing).

*B. esquirolii* Gagnep.: China: Yunnan (Yuanjiang, Xingping, Binchuan, Eryuan) and Guizhou (Guiding).

*B. flava* (De Wit) Cusset; Malaysia: Malay Peninsula: Langkawi Is..

*B. godfroyi* Gagn.: Cambodia: Pursat.

*B. harmsiana* Hosseus: Cambodia: Battambang.

*B. hypoglauca* Tang et Wang ex T. Chen: China Yunnan (Guangnan, Xianshan).

*B. lingyuenensis* T. Chen: China: NW Guangxi.

*B. longistipes* T. Chen: China: Yunnan (Yongsheng).

*B. oxysepala* Gagn.: Vietnam: Ha Son Binh, Thanh Hoa.

*B. penicilliloba* Pierre ex Gagn.: Cambodia: Stung Treng. Laos: Savannakhet, Sithandone. Vietnam: Dac Lac.

*B. venustata* T. Chen: China: Guangxi (Guixian, Yongning).

The distributional data are collected from specimen records and several floras and monographs (de Wit, 1956; Larsen et al, 1980, 1984; Chen, 1988).

### Methods and material

The data matrix (Table 1) was analyzed using Paup 3.0 (Swofford, 1991) on a Macintosh Plus microcomputer. Settings: Heuristic, accelerated transformation, all characters ordered.

A computerized cladistic analysis based upon the principle of parsimony does not require decisions about polarity to be made for characters beforehand. Including an outgroup or ancestral taxon in the analysis, the program decides character polarities based on the same parsimony criterion used in the reconstructing of phylogenetic tree (Andersen, 1991).

Palynological characters show that *B. yunnanensis* Franch has the same type of pollen with sect. *Lasiobema* species (Larsen, 1975). The cladistic analysis of the genus *Bauhinia* on series level also supported the sister group of sect. *Lasiobema* is the Yunnanentes-Corymbosae clade. *B. yunnanensis* was thus used as the outgroup in building the cladogram of *Lasiobema*.

### Characters

All characters are morphological or leaf venational characters. Characters are recorded from herbarium and laboratory material. Venation data are from a treatment of leaf venation of the tribe *Cercideae* by the same author (Zhang, in

prep). Only morphological characters are used in the analysis.

1. Leaf on flowering branch: free leaflets (a) bilobed (b) entire (c)
2. Leaf: glabrous (a) pubescent on lower surface (b) pubescent on both surface (c)
3. Inflorescence: panicle (a) slender raceme (b)
4. Pedicel: much longer than inflorescence internode length (a) nearly equal (b)
5. Bract: subulate (a) linear (b)
6. Position of bracteoles on pedicel: lower part (a) upper part (b)
7. Bud: fusiform (a) subglobose (b) globose (c)
8. Bud: otherwise (a) 5-linear (b)
9. Bud: otherwise (a) 5-dentate (b)
10. Bud: calyx lobes not covering petals before anthesis (a) calyx lobes closed (b)
11. Bud: longer than 0.8 cm (a) 0.8-0.5 (b) shorter than 0.5 cm (c)
12. Calyx: split to 5 lobes (a) 2-3 lobes (b)
13. Calyx: only upper part split (a) split to the mouth of hypanthium (b)
14. Petal: glabrous (a) partly hairy (b) wholly hairy (c)
15. Petal: margin smooth (a) otherwise (b)
16. Petal: claw longer than blade (a) blade longer (b)
17. Petal: obovate (a) lanceolate (b)
18. Filament: glabrous (a) hairy (b)
19. Ovary: wholly hairy (a) hairy on suture (b) glabrous (c)
20. Gynophore: longer than half length of ovary (a) not so (b)
21. Style: stout (a) slender (b)
22. Stigma: inconspicuous (a) capitate (b)
23. Disc: not swollen (a) swollen (b)
24. Disc: glabrous (a) hairy (b)
25. Pod: obovate (b) strap-shaped (b) elliptic (c)
26. Pod: longer than 6 cm (a) 6-4 cm (b) shorter than 4 cm (c)
27. Pod: wider than 2.5 cm (a) less than 2 cm (b)
28. Venation: veinlets simple or once-branched (a) twice-branched (b)
29. Venation: veinlet in most areoles (a) not so (b)
30. Venation: areoles moderate (a) very big (b)

Table 1. Data-matrix of *Lasiobema*

<i>B. yunnanensis</i>	aabab? babaabbaabaacaab?? aaaaab
<i>B. longistipes</i>	bbbabbbababbbbabaacaabaa?? aab
<i>B. comosa</i>	bcabbbbaabaabbabaacbaabababbab

<i>B. esquirolii</i>	bcbabbbbabbbaabaacbaabababbab
<i>B. scandens</i>	cabbaacaaacbaaabaacababbccbbab
<i>B. delavayi</i>	bbbaaaabaabaabababbbbaaacbaab
<i>B. apertilobata</i>	bbaababaabbabbabaabaaabaaaaaba

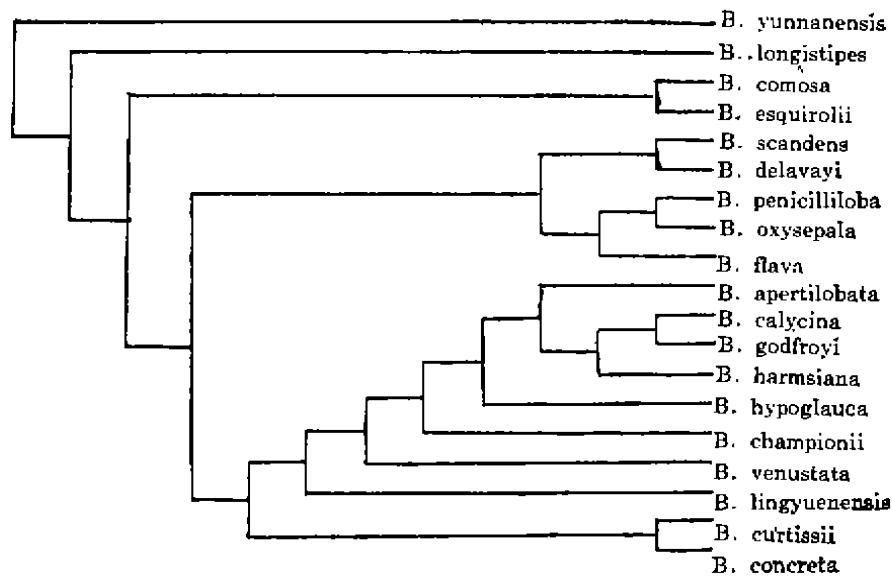


Fig. 1 One of the eight most parsimonious cladograms.

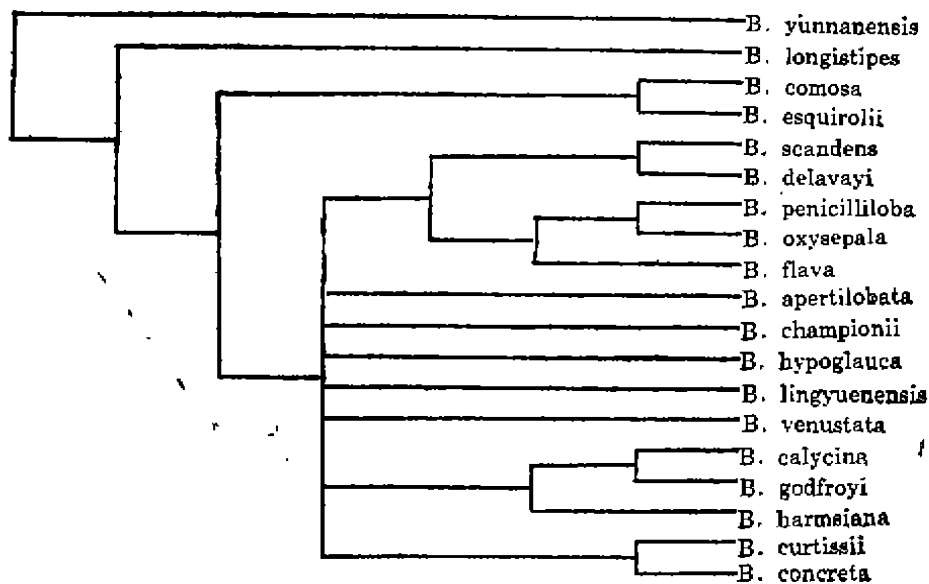


Fig. 2 The strict consensus tree of eight trees

<i>B. championii</i>	cbbaaabaaababbabaaabbaabaaaaaba
<i>B. hypoglauc</i>	bbbaaabaaababbabaaabbaabaaaaaba
<i>B. lingyuenensis</i>	cbbaaabaaababbbbbaabbaaba??? aba
<i>B. venustata</i>	cbbaaabaaababbabaaabaabababababa
<i>B. calycina</i>	cbbaabaaabcbbbbabbacababa???????
<i>B. harmsiana</i>	bbbbbaabaabcbabbbaababbbbbaaaaa
<i>B. penicilliloba</i>	bbbabaahabaaacabbacbbababbbbabb
<i>B. curtissii</i>	cbbaabbaaabbbbbaaacbaababbbtaba
<i>B. flava</i>	bbbbbaabaabbaacabaacababababababa
<i>B. concreta</i>	cbbaaacaacbbabaacbaababbbbaba
<i>B. oxysepala</i>	bbbaabababbabcbabbacbbaba???????
<i>B. godfroyi</i>	bbbaabbaabcbbbbbaaacbbaba???????

## Results and discussion

Eight trees with length of 85 steps (Fig. 1, one of them) and a strict consensus tree (Fig. 2) were produced.

Some clades appear in all cladograms produced. But the interposition of some clades need further studying.

In the ingroup, *Bauhinia longistipes* is the sister taxon of all others together in all cladograms produced. The next one to produce is always the (*B. comosa* *B. esquirolii*) clade.

The ((*B. scandens*, *B. delavayi*), (*B. flava*, (*B. oxysepala*, *B. penicilliloba*))) clade is another stable clade. But the position of it is changeable. So are the (*B. curtissii*, *B. concreta*) clade and the (*B. harmsiana*, (*B. godfroyi*, *B. calycina*)) clade.

The positions of other species on cladograms are very unstable. Only if more data were available can a general conclusion be made.

Species in a clade are usually biogeographically closely related. It is shown by the (*B. comosa*, *B. esquirolii*) clade in Southwestern China, the (*B. curtissii*, *B. concreta*) clade and the ((*B. penicilliloba*, *B. oxysepala*) *B. flava*) clade in Indochina and the Thai-Malay Peninsular, the (*B. harmsiana*, (*B. godfreyi*, *B. calycina*)) clade in Cambodia.

One clade of the outgroup, *B. yunnanensis* Franch. occurring in West China, another clade of the outgroup, ser. *Corymbosae*, having almost the same distributional area as the ingroup. The earliest clades of the ingroup are also from Southwestern China. Whether it is a general biogeographic pattern can only be tested by other groups with a distributional area comparable. More detailed account of the evolution and biogeography of the present group need further study-

ing.

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