西双版纳竹类种质资源、利用和迁地保护*

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摘 要： 西双版纳自然分布竹类资源19属60种，天然竹林面积14 317hm^2，占西双版纳总面积的5.92%是中国乃至世界上竹类资源最为丰富的地区之一。中国科学院西双版纳热带植物园从20世纪60年代初就开始进行竹类资源的种类与分布、人工栽培与利用以及迁地保护等方面研究，并在园内建立了一个面积为8 hm^{2}竹类资源迁地保护区。到目前为止，已从中国热区和东南亚国家收集保存竹类资源27属211种，现已有11种开花结果，用其种子繁殖育苗并栽培同一区内，长势较好，该竹类资源的迁地保护已成为中国从事竹类资源植物研究与保护的重要基地，并为地方经济的发展提供重要的资源贮备。
关键词： 西双版纳；竹类资源；利用；迁地保护

Bamboo Resources Utilization and Ex-situ Conservation in Xishuangbanan*

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Abstract: Xishuangbanna has 60 species of 19 genera, and the natural bamboo forests cover 14 317 ha, making up 5.92% of the total area in the place. Xishuangbanna Tropical Botanical Garden of Chinese Academy of Science began the research on bamboo species and their distribution, bamboo cultivation and utilization, Ex-situ conservation, etc, and a 8 ha bamboo resource Ex-situ conservation area was established in the garden. Up to now, the garden has collected 211 species of 27 genera from tropical area in China as well as the Southeast countries. About 11 species have been bloomed and seeded, and the bamboo seedlings propagated with the seeds are cultivated in the garden with robust growth. The garden has become the important base in China to work on bamboo resource research and protection, which can help the local economic development.
Key Words: Xishuangbanna; bamboo resources; utilization; Ex-situ conservation.

Introduction

Bamboo is woody grass belonging to the sub-family *Bambusoideae* of the family *Poacae*. World-wide there are more than 1 250 species under 75 genera of bamboo, which are unevenly distributed in the various parts of the humid tropical, sub-tropical and temperate regions of the earth (Subramaniam, 1998).

Bamboo is the most diverse group of plants in the grass family, as well as forming the most primitive sub-family. There are distinguished by have woody culms and complex branching, a complex and generally robust rhizome system, and infrequent flowering (Soderstrom and Calderon, 1979). Bamboo has a cosmopolitan distribution, ranging from

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46 to 47 latitude, reaching elevations as high as 4 000 m in parts of China. Bamboo is very adaptable, with some species being deciduous and others evergreen, although at least some species seem to be able to change this habit when necessary.

Bamboo is difficult to hybridize since its flowers are monocarp and most species flower gregariously at long periodic intervals (60~120 years); this helps explain why propagating bamboo by seeds is not very popular. While vegetative propagation is possible, it is seldom practiced in captivity. Bamboo can meet industrial and rural requirements, check erosion, and conserve soil. It can be directly sown or planted as rhizomes, culms cuttings, or nursery-raised seeding. Because of its extensive rhizome and root system, bamboos are useful for soil erosion control and road and stream embankment stabilization. Bamboo can be extremely important in providing vegetative cove to deforested areas. it produces a leafy mulch on the soil surface, its foliage provides shade and protection against rains, and its habit of producing new culms from rhizomes enables the culms to be harvested without disturbing the soil (Soderstron and Cailden,1979) .

Bamboo forest may yield more raw materials more quickly for rural people than do forest, even some types of forest plantations. Some species of bamboo produce annual yields of over 10 t/hm^2, though Lies (1985) concludes that the sustainable yield can generally be assumed to be 2~4 t/hm^2 as under-storey and 5~12 t/hm^2 from plantations, which higher values on good soils with scientific management aided by fertilizers. While bamboo historically has been so common that no particular management was considered necessary, increasing demands from the rural population, urban centers, and international trade are leading to declining stocks and increasing concern about conservation in support of development.

1 Location and topography

Xishuangbanna is situated in the south part of Yunnan, lies between 21°8′ and 22°36′ N, 99°56′ and 101°51′ E the region, which borders Burma and Laos, is mountainous at the northern margin of mainland Southeast Asia and also the southern end of the Hengduan Mountains. Basically, the area has mountain-valley topography with mountains running north south with lower elevations south award. Altitude varies from 477 m at the bottom of the lowest valley in the south to 2 429 m at the top of highest mountain (Hua zhuliangzi Mountain).

The region of Xishuangbanna has a typical monsoon climate with hot warm and humid. The annual mean temperature is 22℃(600 m alt.) to 18.4℃(1 600 m alt.), and the annual temperature accumulation (the sum of daily temperature means where they are >10) is 8 000℃ to 6 600℃;the monthly mean temperature is 15.9℃ to 12.3℃ for the coldest month and 25.7℃ to 22℃ for the hottest month. The annual precipitation varies from 1 200 mm to 1 556 mm, of which more than 80% falls during the rainy season, which starts in May and lasts till the end of October.

The Hengduan Mountains to the north of the region act as huge barrier keeping put the cold air from the north in winter. Dense fog always exists during the whole dry season on the lower hills and in the valleys, average 146 foggy days per year and 1mm precipitation per foggy day recorded in Menglun Town (Liu W.J., 2001). This compensates for the insufficient precipitation, so that a tropical moist climate occurs locally in spite of the fact that the region is controlled by strong monsoon climate and at a relatively high latitude and elevation.

2 Taxonomy and distribution

Bamboo varies in height from dwarf, one-foot (30 cm) plants to giant timber bamboos that can grow to over 100 feet (40 m). It grows in a lot of different climates, from jungles to high on mountainsides. Bamboos are further classified by the types of roots they have. Some, called runners, spread exuberantly, and others are classified as clumbers, which slowly expands from the original planting. There are also varieties of root systems that are a mixture of these types. Generally, the tropical bamboos tend to be clumbers

and the temperate bamboos tend to be runners.

Dransfield (1988) points out that a formal and overall classification of the woody bamboos have not been prepared and broadly accepted, but an estimate of about 60~75 genera and 1 250~1 500 species seems generally accepted, 64% of which are native to Southeast Asia. 33% grows in Latin America, and the rest in Africa and Oceania. In North America there are only 3 native species of bamboo as opposed to the 440 species native to Latin America. Sharma (1982) provided a list of 192 species of bamboo from the Asia-Pacific region, including both native and cultivated species.

Xishuangbanna is one of the richest areas of bamboo in China and the world. The taxonomy of bamboo in Xishuangbanna is not clearly. Wang K.L.(1994) claimed that Xishuangbanna has some 60 species of bamboo in 19 genera(Table 1), Covering 14 317 hm^2 of which 197 819 hm^2 are native forests in the Xishuangbanna national natural reserve (Dao J.H., 2001). The species of bamboos was more than Papua New Guinea, Thailand, Burma, Philippines, Indonesia, Malaysia and Bangladesh. And it was 20% of China species of bamboos; nonetheless the area of Xishuangbanna was only 0.2% of Chinese area. But there are 10 genera only one species; the largest genera are *Dendrocalamus* with 13 species.

3 Geographical distribution and types of bamboo

An estimated 8.96 million ha forest area of the country contains bamboo (Rai and Chauhan, 1998). Bamboo generally forms the under-storey in the natural forests. It is found to grow practically all over the country, particularly in the tropical, sub-tropical and temperate regions where the annual rainfall ranges between 1 200 to 4 000 mm and the temperature varies between 16°C and 38 °C. The most suitable conditions for the occurrence of bamboo are found in between 770~1 080 m above sea level. Dransfield (1988) points out that a formal and overall classification of the woody bamboos has not yet been prepared and broadly accepted, but an estimate of about 60~75 genera and 1 250~1 500 species seems generally accepted. In China, there are about 48 genera and over 500 species, and there are about 28 genera and over 200 species in Yunnan.

Xishuangbanna is very rich in bamboo diversity. There are 19 genera and 60 indigenous and exotic species, found naturally and/or under cultivation. Area

Table 1 Geographical distribution of bamboo genera and species

Genera	Xishuangbanna	India	Thailand	Burma	Bengal
Ampelocalamus	1	0	0	0	0
Bammusa	14	22	14	19	9
Cephalostachyum	2	7	2	2	1
Chimonobambus	1	1	0	1	0
Chimonocalamus	1	1	0	1	0
Dendrocalamus	13	12	8	11	6
Dinochloa	1	2	2	2	0
Fargesia	1	0	0	0	0
Gigantochloa	6	5	3	9	0
Indosasa	3	0	0	0	0
Leptocanna	1	0	0	0	0
Melocalamus	4	1	1	1	2
Neohouzeaua	1	2	0	4	1
Pleioblastus	1	1	0	0	0
Pseudostachyum	1	1	0	2	0
Phyllostachys	4	5	0	3	0
Schizostachyum	3	2	2	1	0
Thyrsostachys	2	2	2	2	1
Yushania	1	0	0	0	0
Total	60	64	34	58	20

of bamboo forest is 9.91*104 hm^2, and most of bamboo forest is native forest (Wang K.L., 1994). Clump forming bamboos constitute over 80% of the total growing stock, of which *Dendrocalamus* is 45%. A non-clump forming bamboo, accounts for 20% of the growing stock. Bamboo falls into two main categories according to growth pattern, (1) sympodial or clump forming, and (2) monopodium or non-clump forming, running bamboos.

4 Cultural values of bamboo

Porterfield (1933) suggested that " bamboo is one of those providential developments in nature which, like the horse, the cow, wheat and cotton, have been indirectly responsible for man's own evolution ". In china, bamboo is one of the four noble plants, the others being the orchid, the plum tree and the chrysanthemum. Bamboo was closely connected with the daily lives of people in ancient China. Su D. P. (1 037~1 101), a literary giant of the Song Dynasty (960~1 279), said that " A meal should have meat and a house should have bamboo. Without meat we become thin, without bamboo we lose serenity and culture itself ", and used bamboo as firewood and to make tiles, paper, rafts, hats, rain capes, and shoes. At that time, as today, bamboo shoot were eaten as a popular dish because of their crispness and fresh, sweet taste. Bamboo shoot also contains vitamins, Sugar, fat and protein. In the Han Dynasty (206 B.C.-A.D.220) bamboo was used for papermaking because it produced high-quality paper and was inexpensive: three tons of bamboo could yield one ton of paper pulp. And bamboo is still an important raw material for papermaking today. Some 1600 years ago. People wrote with brushes on Xuan paper made from young bamboo. And Xuan paper is still popular for Chinese calligraphy and paintings.

Bamboo's resistance to stretching and its ability to support weight are at least double those of other kinds of wood, making bamboo an ideal material for houses, scaffolding, supporting pillars, and work sheds. Tall and graceful with luxuriant foliage, bamboo is an ideal plant for household courtyards and parks. It tolerates the heat of summer and the cold of winter, it grows on unfertile land, and it regenerates after being cut. Throughout the centuries, bamboo has inspired the imagination of artists, while men of letters have written poetry and prose to express their admiration for the purity and elegance of bamboo. They compared the qualities of bamboo to those of man, and Su D.P. attributed his literary inspiration to bamboo. Bamboo was also a favorite subject of noted Chinese painters of past dynasties.

Bamboo is both decorative and useful. In many parts of the world it is food, fodder, the primary construction material and is used for making great variety of useful objects from kitchen tools, to paper to dinnerware. They are growing so fast that they are considered to be rapidly renewable resources; some species under ideal condition could grow to full height in three to four years for harvesting.

4.1 Bamboo and construction

In construction, bamboo provides pillars, floors, walls, doors, window frames, rafters, and room separators, ceilings, and roofs. In ancient Xishuangbanna, especially Dai people's communal houses that may be 30m long are built of bamboo, even on very tall buildings. Bamboo is used to make guard houses in rice fields, road-side food shops, hothouses for growing mushrooms, smoke houses for drying tobacco or cardamom, store houses for rice or corn, and livestock sheds. Bamboo is used to make pegs nails. Many villages use bamboo shingles, with the large stems split in half and laid them alternately with the convex and concave side upwards, with the edges overlapping; in coastal areas, roofs often are made of that woven from palm around Longwood slivers of bamboo. Bamboo is used to make furniture, often without recourse to nails or glue, as the main framing members are notched and tapered to fit together like the pieces of a puzzle. The seats are commonly made of slender bamboo slats.

Bamboo is used throughout fields to build bridges of many types and sizes; they can be as long as 25 m,

often involving sophisticated technology as suspension bridges but also simple technology in the form of pontoon bridges.

Dai people have good technology for build bamboo houses. First, autumn is good time for cut bamboos, bamboo isn' t easy be vermiculated by bamboo worm; second, for enhance identity of un-curve, bamboo wood be marinated in river or ponds a long time; third, we must select different bamboo species for different part of houses. (i) We should select big stems bamboo species for pillars, for example, *Dendrocalamus ginanteus* Munro, *D.sinieus* Chia et J.T.L.Sun. (ii) We should select bamboo species for walls and floors, which have good hardness and anti-morth, and anticorrosive. For example, *D. membranceus* Munro, *D.barbatus* Hseuen et D.Z. li, *Gigantochloa ligulata* Gamble, *Bambusa sinospinosa* McClure et. (iii) We should use middle or small stems bamboo species for rafters, which have good hardness, thick stems, for example, *Chimonobambusa quandrangulasis* (Fenyi) Makino, *Thyrsostachys siamensis* Gamble, *Gigantochloa nigrociliata* (Buse) Kurz, et al.

Today, bamboo is widely used for household articles such as mats, beds, pillows, benches, chairs, cabinets, buckets, chopsticks, spoons, baskets, and handheld fans.

4.2 Bamboo and food and cooking

The use of bamboo in food and cooking goes far back in history, and starts with making fire-bamboo is used to construct a fire-saw, using bamboo shaving for tinder. In Xishuangbanna, *Cephalostachyum pergracile* Munro is good for roast rice, tubers and rice are cooked in a length of bamboo which is then steamed or roasted over a fire; this provides useful "trail food", which can be taken on hunting trips or to distant rice fields to be eaten as a simple meal requiring no additional cooking. In general, there are three ways of made bamboo shoot in Dai people. Bamboo is used to construct frameworks for cooking pots over hearths in longhouses, and provides beakers for drinking water, beer, and various kinds of liquor.

4.2.1 Fresh bamboo shoot There are two parts in Xishuangbanna fresh bamboo shoot, one part is the best vegetable, which can be used directly cooking, **for example,** *Dendrocalamus hamitonii* Nees et Arn., *D.semiscandens* Hsueh et D.Z.Li, *Schizostachyum funghomii* McClure et. The other has bitterness; we should steam the shoot for remove the shoot bitterness before cooking. Fro example, *D.giganteus* Munro, *D.barbatus* Hsueh et D.Z.Li, *D. membranaceus* Munro,*Pseudostachyum polymorphum* Munro,*Gigantochloa nigrociliata* (Buse) Kurz. Leptocanna chinensis (Rendle) Chia et H.L.Fung. Exception, Indosasa singulispicula Wen is good price in local market, especially Dai people like gather and indirectly cooking, it was name "bitter bamboo" in Xishuangbanna.

4.2.2 Acid bamboo shoot Acid bamboo shoot is good food in Xishuangbanna, not only single cooking, but also as additive for cooking, for example, boiling fish with acid bamboo shoot, steam check with acid bamboo shoot, fry beef with acid bamboo. In general, *D.giganteus* Munro, *D.barbatus* Hsueh et D.Z.Li, *D. sinicus* Chia et J.L.Sun, *D.membranaceus* Munro, *Pseudostachyum*. Those can be used to make acid bamboo shoot.

4.2.3 Dry bamboo shoot dry bamboo shoot is the largest product in Xishuangbanna bamboo shoot, whish is easy to produce, reserve and transportation. Most of bamboo species in Xishuangbanna can be used for making dry bamboo shoot.

Among the edible bamboos, *Dendrocalamus hamilttonii* Nees et Arn. is the most favorable, followed by *D.brandisii* (Munro) Kurz., *Cephalostachyum pergracile* Munro, and *D.membraanaceus* Munro.

4.3 Bamboo and folk feast and religion activity

Bamboo is closely relative with folk feast and religion activity in Xishuangbanna Dai people. In water-splashing Festival every year, Dai people must make and set off "gaosheng" (original rocket), it was made of the bamboo stem of *Schizostachyum funghomii* McClure, *S. pseudolima* McClure. And

most Dai people made and set off" kongming lamp" in the evening, it be made of bamboo stem of *Cephalostachyum fuchsianum* Gamble. " Yanhua "(original pyrotechnic) is very popular in Xishuangbanan, it was made of powder and saltpeter and load into the stick of bamboo, most of *Dendrocalamus* bamboo species can be used to make " yanhua ", for example, *Dendrocalamus giganteus* Munro, *D.sinicus* Chia et J.L.Sun, *D. barbatus* Hsueh et D.Z.Li, *D.membranaceus* Munro, et.

Bamboo can be used in the temple fair of Dai people's feast, which was holding one time every year. For example bamboo skep is made, hanging paper flower, soap, towel or hand towel, and cash by bamboo stick.

In Dai temple, people should plant " temple tree" which is symbol tree of every Buddha around the temple. As it is said, *Bambusa sinospinosa* McClure is the twenty-eighth temple tree.

4.4 Bamboo and the arts

In the rich art of China and Japan, bamboo provides paper, brush, and the artist's subject. Some of the fine brushes used in Chinese paintings are made of fine bamboo shavings with a small holder of bamboo. It is used to make traditional Chinese musical instruments such as the Sheng, a reed instrument; the " dizi "(one flute); and the " xiao "(one flute) held vertically. Woven bamboo arts and crafts come in a wide variety, including toy animals, lanterns, flower baskets, trays, tea boxes, screens, and curtains. And it is also widely used for musical instruments of three types, percussion or hammer instruments, blown or wind instruments, and stringed instruments. Bamboo weaving is popular in the provinces of Guangdong, Fujian, Hunan, Sichuan, Anhui and Zhejiang which has a history of bamboo woven going back for more than 2000 years.

In Xishuangbanna Aka people, a popular dance is the bamboo pole dance, where two people sit and hold two bamboo poles at both ends. As the dancers ' feet skip in and out of the space between the poles, the bamboos are brought together in time with the rhythm. Suspense is introduced because a dancer missing the beat will have his or her foot painfully caught between the thick bamboo poles.

4.5 Bamboo and hunting and gathering

Bamboo is used into a wide variety of weapons. In Xishuangbanna, some people use bamboo to make blowpipes for hunting small animals such as monkeys and squirrels. Bamboo reeds are used as fish arrows. It is also widely used to make handles of spears and knives. And villagers gather shellfish and worms by quivering a twig of bamboo down a hole and luring up the prey.

Bamboo is widely used for making traps for animals or fish, ranging from sophisticated cage traps to simple deadfalls and pit traps with sharpened bamboo spears at the bottom of the trap. Make bamboo pipes with which to imitate the calls of deer and some birds, thereby luring then close enough to be shot.

4.6 Bamboo and medicine

Bamboo is also used in Chinese medicine. The leaves eliminate heat and phlegm; the juice cures strode, insanity, and a kind of asthma caused by excessive phlegm; and the root can stimulate the vital forces, quench thirst, and promote lactation. In Xishuangbanna Dai medicine, the culm of *Dendrocalamus hamilttonii* Nees et arn. Is invigorant of kidney, in the famous medicine book " Dang ha ya" was recorded the prescription by *Thyrsostachys siamensis* (Kurz.) Gamble, *Pseudostachyum polymorphum* Munro and *Dendrocalamus* spp..

Bamboo is an extremely useful grass that is in high demand throughout in Xishuangbanna, China, with a commercial economic value of about 10 million per year. Because of the bulkiness of bamboo culms and the high value ratio of bamboo, the radius of economic transport and products technologic are limited so most bamboo is used near the centers of Xishuangbanna.

5 Conservation of Bamboo

In Xishuangbanna, most bamboo is extracted directly from forests, with almost 90% coming from natu-

ral stands, and 10% coming from cultivated sources. In any case, very little explicit attempt is made to conserve bamboo, and it appears that most conservation organizations see little need to give attention to bamboo when so many other species seem to deserve higher priority. However, given the cultural, social, economic, and biological importance of bamboo as outline above, it may be timely to give careful consideration to the status and trends of bamboo, and to take corrective action if such is required.

Both In-situ and ex-situ conservation measures are being adopted to preserve the genetic resources of bamboos. In-situ conservation measures include establishment of preservation plots in Xishuangbanna. In addition, there are 5 biosphere reserves (Dao J.H. 2001), which include the natural habitat of bamboo as well. The local people in sacred groves also protect these species. However, in-situ conservation sites with specific emphasis on conservation of bamboo are yet to be established. The major limitation of in-situ conservation is that natural stands of bamboo are scattered in pockets over large areas making it difficult to declare several bamboo reserves.

Ex-situ conservation activities for preservation of important genetic resources of bamboo need more emphasis. The live collections of bamboos are now available only in a few centers in China. For example, Zhejiang Bamboo BG (250), Bamboo garden of Fuzhou Arboretum (222), Xishuangbanna Tropical BG (245), South China BG (170), Hangzhou BG (100), Nanjing forestry university BG (100). In Xishuangbanna, there is one and only Ex-situ conservation of Bamboo, which is bamboo collection of Xishuangbanna Tropical BG.

In Xishuangbanna tropic botanic garden, Bamboo introduction was started in 1961, and build Ex-situ conservation of bamboo in 1983. To now, there be about 508 species time was introduced into XTBG, and 211species with 27genera was reserved in the Ex-situ conservation of bamboo. There into, 54 species with 18genera was collected from Xishuangbanna, it was cover 90% all species of bamboo in Xishuangbanna. And 49 species with 17 genera was collected from Yunnan Province (except Xishuangbanna); 95 species with 19 genera was collected from other province in China (except Yunnan Province). Only 13 species with 4 genera was collected from foreign country, and all species from Laos or Burma.

Bamboo is characterized by periodic synchronous flowering followed by death and subsequent regeneration. This synchrony may involve a few clumps, a patch, a whole mountainside or drainage. To now, there is 11 species of bamboo being flowered and seed, and reproduced by those seeds in XTBG.

6 Conclusions and suggestion

Wang K.L.(1994) and Dao J.H.(2001)consider the future prospects of bamboo to be bright, especially with increasing inputs from modern technology in bamboo production. Bamboo is of outstanding cultural, economic and biological importance in Xishuangbanna, but increasing human populations and expanding demands on resources require a more carefully considered approach to managing bamboo. Such an approach should include:

6.1 Scientific research to better understands the taxonomy, distribution, and biology of bamboo. Need to expand their field collecting activities to support further work in taxonomy as basis for investigating additional uses of bamboo; and to assess the status and distribution of the various species. Ecological relationships with other species also need to be investigated, with a view to improving management. It would be extremely useful to prepare an identification key for bamboo based on vegetative characters rather than flowers, since the latter emerge so infrequently. Scientists also need to conduct further research on the lifecycle of the various bamboos and the reasons for mass flowering, in hopes of developing the capacity to predict flowering and initiate appropriate management procedures.

6.2 Increasing incentives to local people to grow bamboo and to use existing bamboo on a sustainable basis.

Table 2 genera and species in Ex-situ conservation of bamboo in XTBG

Genera	No. Species	No. Species of Xishuangbanna	No. Species of Yunnan	No. Species of other province	No. Species of foreign country
Bambusa	58	12/14	8	34	4
Cephalostachyum	5	2/2	3	0	0
Chimonobambusa	6	1/1	3	2	0
Chimonocalamus	4	1/1	2	1	0
Dendrocalamopsis	2	0/0	0	2	0
Dendrocalamus	33	11/12	12	10	0
Drepanostachyum	3	0/0	0	3	0
Dinochloa	4	1/1	3	0	0
Fargesia	3	1/1	2	0	0
Gigantochloa	9	5/6	2	2	0
Indocalamus	4	0/0	1	3	0
Indosasa	11	2/3	2	3	3
Lingnania	3	0/0	0	3	0
Leptocanna	3	1/1	1	1	0
Melocalamus	4	3/4	0	1	0
Neosinocalamus	2	1/1	1	0	0
Oligostachyum	1	1/1	0	0	0
Pieioblastus	5	1/1	0	3	1
Pseudostachyum	2	1/1	0	0	1
Phyllostachys	13	4/4	1	5	3
Pseudosasa	10	0/0	2	7	1
Sasa	1	0/0	0	1	0
Schizostachyum	8	3/3	3	2	0
Sinocalamus	11	0/0	1	10	0
Teinostachyum	1	0/0	0	1	0
Thyrostachys	2	2/2	0	0	0
Yushania	3	1/1	2	0	0
Total	211	54/60	49	95	13

Note: 12/14 means that 12 species was conserved in XTBG and 14 species was found naturally and/or under cultivation in Xishuangbanna.

Local people not only should be given increased responsibility for managing their own bamboo resources. But also should be given to the cultivated varieties of bamboo, especially those which support local village requirements.

6.3 Establish protected areas or collection (bamboo garden) of bamboo, devoted to the conservation of bamboo and the species dependent on it, and increasing research on Ex-situ conservation of bamboo and utilize these and public education. More BG should raise different kinds of bamboo both to demonstrate the great diversity of these grasses and to build public awareness. BG should also investigate ways of raising bamboo artificially, from seeds or by planting rhizomes, culm cuttings, and nursery-raised seedlings.

6.4 Increasing collected and conserved species of bamboo from Southeast Asia. Of the estimated 180 species of bamboo found in Southeast Asia, 100 species are indigenous to the region and have relatively limited distributions, about 30 are found only in cultivation and were probably brought in from other parts of Asia over the 3000 years, and about 125 species are growing wild in their natural habitat but have been brought into cultivation in other regions (Widjaja and Dransfield, 1989). Clearly, then, the distribution of bamboos has been greatly modified by human intervention; we should increase collect and conserve those.

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毛竹林内夏季气温变化的特征比较

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摘 要： 定位研究位于浙江省富阳市的不同结构毛竹林，2003 年夏季林内气温的日变动状况。结果表明：毛竹林内以日最低气温的变异幅度最大，日最高气温次之，日均气温最小；毛竹纯林内日均最低气温 21.20℃，低于竹阔混交林 1.32℃，日均最高气温为 29.67℃，低于竹阔混交林 1.03℃。毛竹林内最低气温主要出现在凌晨 4:00~6:00，毛竹纯林调节林内最低气温的效应值与栎林相似约 -0.3℃，竹阔混交林效应值约 1.25℃。方差分析显示毛竹纯林、竹阔混交林、茶园 3 类林分间的日均气温差异极显著，日最低气温差异显著。

关键词： 毛竹林;夏季;林内气温;日变化

Characteristics Comparison of Air Temperature in *Phyllostachys pubescens* Stands in Summer

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Abstract: This paper deals with a studied on daily variation of summer air temperature in different structures of *Phyllostachys pubescens* stands sited in Fuyang county of Zhejiang province in period from June 10 to July 15 in 2003. Results showed: the variation range of the lowest daily temperature in pure *Phyllostachys pubescens* stands was the broadest, However the highest daily temperature inferior to the lowest daily temperature and daily average temperature is the minimum; The average of the lowest daily temperature of inside pure *Phyllostachys pubescens* stands was 21.20℃ that lower than mixed *Phyllostachys pubescens* with broadleaved tree stands (mixed stands as follow)was 1.32℃, While the average of the highest daily temperature of inside pure *Phyllostachys pubescens* stands was 29.67℃ that lower than mixed stands was 1.03℃. Air temperature of the daily lowest in inner stands of *Phyllostachys pubescens* stands appeared at 4:00~6:00, Meanwhile it had special ability for adjusting the lowest air temperature in pure *Phyllostachys pubescens* stands, that the efficiency value nearly -0.3℃ was similarly to oak stands while it was 1.25℃ of mixed stands. ANOVA results showed it existed the extremely obviously difference of the diurnal average air temperature among in pure *Phyllostachys pubescens* stands , mixed stands and tea plantation garden, However existed obviously difference of diurnal the lowest air

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