



Integration and demonstration of key-techniques on the restoration of degraded ecological environment in karst mountain areas: a project sponsored by national S&T supporting program of MOST

To XTBG, this is the largest project (total fund is 45.95 million RMB) ever conducted. The project includes 4 components, 3 of which are implemented by XTBG.

Taking Bijie district of Guizhou Province as study area, the project proposal passed evaluation by the MOST and initiated in 2007. Being a typical karst area in southwest China, the development of Bijie district has attracted great attention from the society. This project will provide scientific basis for the restoration of degraded karst environment.

The objectives of the project are:

- Vegetation restoration and control of rocky desertification in karst areas;
- Development and utilization of traditional Chinese medicinal natural resources;
- Study on ecological animal husbandry development;
- Study and practice of ecological agriculture.



Deputy Director, Mr. PENG Daiping (right), discussing agro-technologies with staff in Bijie district of Guizhou Province



Prof. LIU Wenyao proposes the project to MOST for evaluation



XTBG scientists working in karst areas of Bijie district, Guizhou Province

Landscape Optimization of Tropical Living Collections in XTBG: a constituent component of the third-phase knowledge innovation program of CAS

After the successful completion of "Capability enhancement for species conservation and sustainable development", an important component in the second-phase knowledge innovation program of CAS, the follow-up project "Landscape Optimization of Tropical Living Collections in XTBG" has been initiated.

During 4th-5th December 2007, an expert panel consisted of academicians and Directors of CAS botanical gardens evaluated the success of the second-phase knowledge innovation program and reviewed the proposed project plan for the third phase.

The panel emphasized the necessity and feasibility of this project in the third-phase knowledge innovation program of CAS. The major components of the project comply with the objectives of XTBG's Master plan.

The new living collections will include Energy plants, Wild relatives cultivated plants, Tropical lianas, River bank seasonal rainforests, and typical Asian tropical plant families, and the establishment of a new nursery.



Dr. CHEN Jin, Director of XTBG, reporting project plans to the expert panel



Design of the Tropical lianas living collection



New projects sponsored by the CAS “Light in Western China” Program

In 2007, Asso. Prof. SHEN Youxin's research on the ecological restoration of degraded vegetation in Karst uplands and GAO Jiangyun's study on Ginger Plants received funding from the “Light in Western China” program. To date, fourteen XTBG researchers have been sponsored by the program since 1997.

Facts:

In 2007, XTBG mobilized RMB 17.25 million RMB by contract as research grants for new projects, of which:

- 1 project funded by the national S&T supporting program;
- 7 NSFC-funded projects;
- 7 YNSF-funded projects;
- 2 projects supported by CAS key program;
- 1 project funded by CAS Bureau of International Cooperation;
- 2 projects funded by CAS Office of Agricultural project;
- 8 projects funded by CAS innovative frontier fund for distinguished young scholars;
- 3 subproject funded by national basic research program (973 program);
- 1 project funded by Department of Forestry of Yunnan Province, and
- 10 projects sponsored by other sources.



TANG JW and YU DQ' s projects passed end-of-term evaluation

Research and outreach progress highlights

Screening & Assessment of Energy Plants & Core Technology for Large- Scale Plantation of *Jatropha curcas*

On the basis of fundamental work on energy crops by XTBG since the 1970s, the project of "Screening & Assessment of Energy Plants & Core Technology for Large-Scale Plantation of *Jatropha curcas*" led by XTBG in collaboration with other institutes of CAS, has made encouraging progress. Preliminary assessment on fat metabolism of *Jatropha curcas* and analyses on oil contents have been carried out. In addition, researchers have made observations on growth characteristics and stress resistance of *Jatropha curcas* in different regions, and 5 high-yield field experiments were established.

It is a great breakthrough in the research on bio-diesel, receiving wide attention from leaders of China, CAS and local government, etc. Several batches of visitors from industrial sectors and commercial enterprises intend to collaborate with XTBG in the development of high yield varieties. In accordance with the needs of the nation, XTBG has held a positive role in providing a platform for the study on biomass energy.



Visitors from Indonesia



Team meeting to discuss project progress



Collection of *Jatropha curcas* germplasm



Studies on *Cordyceps sinensis*

Cordyceps sinensis is a fungus that preys upon caterpillars and a rare kind of traditional Chinese medicine, which is only found in cold alpine meadow areas of the Qinghai-Tibet Plateau, Yunnan and Sichuan Provinces. When the larvae of *Hepialus* moths become infected by *C. sinensis*, the mycelium fill the entire body cavity, killing the host. Then a dark brown, finger-like stroma sprouts near their heads. But the mechanism of how *C. sinensis* infects *Hepialus* is not clear.

Because of its medicinal value and high financial profits, *Cordyceps sinensis* has been excessively collected in the past. Now, *Cordyceps sinensis* has become an endangered and rare species and is under state protection (category II). "Excessive collecting of *Cordyceps sinensis* has threatened the ecological environment of the Qinghai-Tibet

Plateau." The destruction of the ecological environment within these areas will lead to a reduction of water sources, according to a survey made by a 12-person XTBG expedition team from 8th June to 2nd July, with the support of a new project granted by CAS key program in 2007.

Professor YANG Darong and his team, based on their previous studies on *Cordyceps sinensis*, are using interdisciplinary research, combining biogeography, biology, ethology, biochemistry, biophysics, and molecular biology, to clarify the infective mechanism between *Cordyceps sinensis* and the host, *Hepialus* moth, through systematic research on specimens collected in the alpine cold meadows mentioned above. Finally, the results could provide scientific basis for the protection of the natural *Cordyceps sinensis* populations and their environment, and for the artificial breeding and cultivation of *Cordyceps sinensis*.



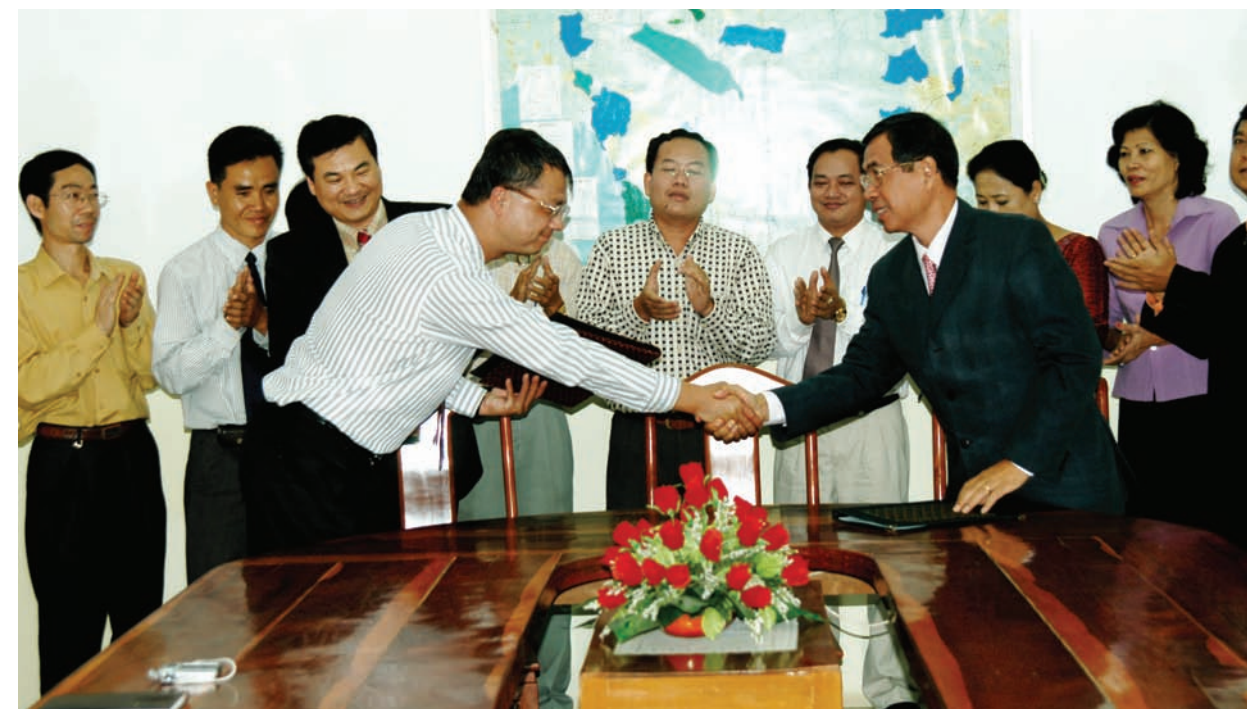
Prof. YANG Darong (middle), collecting wild *Cordyceps sinensis* at Qinghai-Tibet Plateau

Cambodia national botanical garden

In late January 2007, Deputy Director Dr. CAO Min, led a 13-person team on a 23-day field trip to Cambodia, aimed to help Cambodia to set up the first national botanical garden. In close collaboration with national and local government agencies, information about site selection, geography, vegetation, local culture and customs, and tourism market, etc, was collected, a study report was submitted to CAS Bureau of International Cooperation and Department of Foreign Aid of the Ministry of Commerce. Summary meeting was held by the CAS Bureau of International Cooperation at CAS Kunming branch on 31st May 2007.



On-site field trip to Cambodia led by Deputy Director, Dr. CAO Min (right)

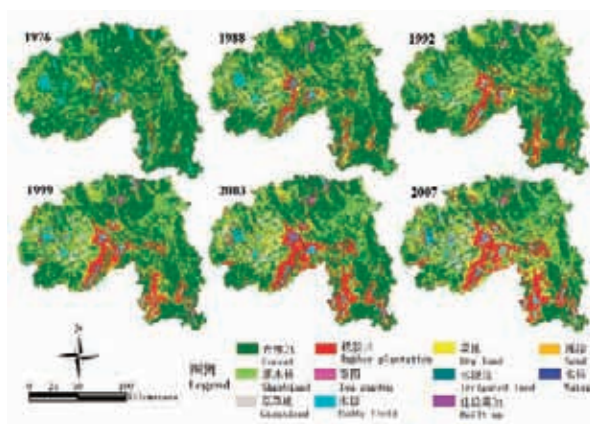


CAS delegations meet with Cambodia Agencies



Xishuangbanna's tropical rainforest, rubber plantation and its consequences

Expanding rubber plantation makes the ecological situation even more vulnerable in Xishuangbanna. During the past 30 years, Xishuangbanna's tropical rain forest has been disappearing at an annual rate of 1.12%. This rapid rate of conversion, largely into rubber plantations, has caused roughly two-thirds of the forest to be lost. Prof. MA Youxin and colleagues reported these important findings in an article published in *Forest Ecology and Management*. "Because the tropical rainforest habitat in Xishuangbanna is perfectly suitable for rubber plantations, the rubber trees are invading intact forest, says Dr. ZHU Hua in the first issue of the online journal *Tropical Conservation Science*. These two scientists also suggested in a recent issue of *Science* that the government should limit new rubber plantations to land now used for other crops. Alternative cash crops, such as teak and other expensive hardwoods, are also recommended by the ecologists.



Land-Use Cover Change (LUCC) in Xishuangbanna during 1976-2007

Moreover, detailed studies of the sources of fog and emissions of volatile organic compounds (VOC) in Xishuangbanna's tropical rainforest were also carried out. Fog was produced mainly through evaporation from pond, river, and soil plus forest evapotranspiration, especially during the dry season, but evaporation from stream was limited, Dr. LIU Wenjie reported in an article published in a top journal of this field: *Agricultural and Forest Meteorology* 2007, 143(1-2): 80~91.



Fog droplets intercepted by spider web

Tropical regions are a major global source of VOC emissions, and the magnitude and chemical speciation of VOC emissions are highly plant-species specific. Therefore it is important to study emissions from dominant species in tropical regions undergoing commercial land-use change, for example, rubber plantations in Southeast Asia. Prof. LI Qingjun and his graduate student WANG Yongfeng showed that composition of the total emissions changed with rising temperature or PAR ramps imposed throughout the day. As well as light and temperature, there was evidence that assimilation rate was also a factor contributing to seasonal regulation of monoterpene emission potential from rubber trees; the research results were published in *Global Change Biology* 2007, 13, 2272-2280.

A new hypothesis to explain plant bio-invasion

Invasive *Buddleja davidii* allocates more nitrogen to its photosynthetic machinery than native woody species, reported Dr. FENG Yulong in new work published in *Oecologia* (2007).

In a series of common garden experiments, the ecophysiological traits of eight populations of the invasive shrub *Buddleja davidii* were compared among a wide range of European locations and five co-occurring native woody species in Germany. The results indicated that the higher nitrogen allocation to the photosynthetic machinery may facilitate *Buddleja davidii* invasion. More studies involving a wide range of invasive species are needed to understand the generality of this pattern and to fully assess the ecological advantages of this characteristics.

Dr. FENG's team is actively pursuing further experiments on invasive and native species in XTBG to understand these critical dynamics.



The invasive shrub *Buddleja davidii*



Bio-invasion along roads



Woody climbers are expected to differ from trees in growth strategies

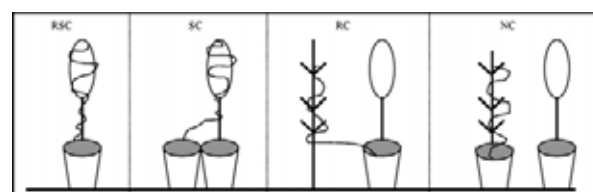


Lianas in tropical forests

As an important component of tropical forests, woody climbers directly and indirectly affect the growth and regeneration of many trees. Moreover, they may change the composition of tree species, and they play an important role in ecosystem-level processes such as biodiversity and carbon sequestration. Woody climbers are expected to differ from trees in their growth strategies. As a result these two groups of woody species will have different spatial distributions: lianas are more common in high light environments. Dr. CAI Zhiqian and co-workers from Wageningen University carried out a study on seedling growth strategies in 5 *Bauhinia* species: comparing climbers and trees. They demonstrated that the two light-demanding liana species had higher relative growth rate (RGR), allocated more biomass to leaf production [higher leaf mass fraction (LMF) and higher leaf area ratio (LAR)] and stem mass fraction (SMF), and less biomass to the roots [root mass fraction (RMF)] than the two tree species. The shade-tolerant liana had the lowest RGR of all five species, and had a higher RMF, lower SMF and similar LMF than the two light-demanding

liana species. The two light-demanding lianas had lower photosynthetic rates per unit area (Aarea) and similar photosynthetic rates per unit mass (A_{mass}) than the trees. Across species, RGR was positively related to SLA, but not to LAR and Aarea. Researchers also investigated the biological characteristic and environmental adaptability and competitions between trees and lianas.

These findings have been published in the journal ANNALS OF BOTANY 2007, 100: 831-838.



Schematic representation of four types of competition treatments between tree and liana



Experiment on two light-demanding liana species which had higher relative growth rate (RGR)

Hydrothermal conversion of lignocellulosic biomass

Lignin (20%), cellulose (50%) and hemicellulose (25%) are the three major constituents of plant biomass. In cooperation with international colleagues, Dr. FANG Zhen, leader of energy biomass group in XTBG, conducted studies on dissolution of wood in water and its subsequent catalytic conversion into H₂-enriched gas. The conversion of glucose into gas with Pt/γ-alumina catalyst was examined in flow experiments, where it was found that 67wt% conversion rate (with up to 44 mol% H₂) could be obtained at 360 °C and 30 MPa.

Besides the above biomass conversions, Dr. FANG also synthesized many nanoparticles that can be used for the promotion of biomass conversions. For example, he synthesized low-dimensional ErOOH nanostructures (nanofibres, nanorods and nanolayers) using a facile hydrothermal method. The ErOOH nanofibres are monoclinic with diameters in the range of 6-30 nm at pH 12. Increasing the pH to 13 led to the production of nanorods instead of nanofibres with diameters of 20-100 nm. Decreasing the pH to 6, had a dramatic effect, causing the formation of a new crystalline phase of star-like nanolayers. Subsequent dehydration of the nanofibres at 800 °C led to the formation of Er₂O₃, which had the same morphology as the nanofibres. According to scientific literature, addition of lanthanum such as erbium-based materials to the Ni-Al catalyst can increase conversion rate of biomass, the gasification experiments of biomass with these nanoparticles are undergoing in the biomass group.

This work was published in FUEL 2007, 86: 1614-1622 and NANOTECHNOLOGY 2007, 18 445606.



Evaluation on Ornamental Characteristics and Selection for Promising Species of Native Plants in the *Zingiberaceae* Family

This project was awarded the 2nd prize for Natural Science in Yunnan at the plenary meeting of Yunnan Science & Technology Award Committee held on 14th November.



Ginger Plants of China (edited by GAO Jiangyun)

Alstonia scholaris plant resource investigation & artificial propagation trial

This demonstration project was awarded the 3rd prize of Science & Technology Progress of Yunnan Province. Jointly conducted by XTBG and a local enterprise, using both wild and cultivated *Alstonia scholaris* in Yunnan and Guangxi as research objects, the project made comprehensive investigation on the biological characteristics, wild population distribution, and traditional utilization, as well as germplasm collection, scientific breeding and cultivation of *Alstonia scholaris*. Three farm forestry patterns have been designed and put into large-scale plantation in four counties of the Simao Prefecture, playing a significant role in poverty alleviation in Simao Prefecture.



The demonstration project was awarded the 3rd prize of Science & Technology Progress of Yunnan province

Tree species screening and afforestation demonstration

Presided by Prof. ZOU Shouqing, a senior scholar of XTBG, in collaboration with CAS Kunming Branch and Yunnan Provincial Government, the project "Screening of good-quality, fast-growing, and high-yield timber tree and forestation demonstration in Simao Prefecture" was awarded first prize of Science & Technology Progress by Simao (now Pu'er) Municipal Prefecture.

Based on the project results, five species (*Bennettiodendron leprosipes*, *Gmelina arborea*, *Manglietia* spp., *Choerospondias axillaris*, and *Betula alnoides*) have been selected and put into large-scale plantation, contributed to the forestation area of over 100,000 mu (6,666 ha) in Simao Prefecture.



Tree species screening and afforestation demonstration project was awarded first prize of Science & Technology Progress by Simao (now Pu'er) Municipal Prefecture

Facts:

In the year 2007, XTBG scientists have achieved the following:

- 46 scientific papers published on internationally peer-reviewed scientific journals (Source Journals of ISI web of Science);
- 95 research papers published on CSCD (Chinese Science Citation Database) referred journals;
- 20 papers presented on international conferences and symposia;
- 2 monographs published by Science and Technology Press of Yunnan;
- 7 invention patents;
- 1 certificated plant varieties.



Improvement of research facility

Savanna Ecosystem Research Station in Yuanjiang County

On 17th October 2007, after listening to the introduction and overall plan and implementation scheme of the project made by Deputy Director Dr. CAO Min, a panel of experts gave a nod of approval to the proposal and feasibility study to establish a research station in the savanna ecosystem of Yuanjiang County, Yunnan Province. The panel also offered constructive suggestions.

Covering about one hectare, the Savanna Research Station will be located in Pu Piao, about 32 km south of the county proper (Yuanjiang Township). Featuring typical dry-hot valley vegetation with rich biodiversity, it is considered as an ideal place for long-term ecological studies.



Field investigation to Pu Piao, Yuanjiang County



Deputy Director, Dr. CAO Min reports to the panel



Deputy Director, Mr. LI Hongwei (front 2), together with other experts, crossing a chain bridge

Comprehensive Platform for Studies on Biomass Energy & Conservation Biology

During 16th-18th April 2007, CAS Kunming Branch organized an assessment meeting at XTBG, to evaluate a proposal to construct the infrastructure for a project entitled "Comprehensive Research Platform for Biomass Research & Biology Conservation" submitted by XTBG. Deputy Director LI Hongwei presented the project's recommendations to the expert panel. Afterwards, the expert panel entrusted by State Reform and Development Commission, made on-the-spot field investigations and reviewed the experiment base for resource plants. The panel reached a unanimous agreement that the project was in line with the 11th five-year plan for National Independent Innovation Ability Construction and in accordance with the general planning and deployment of CAS infrastructure programs. The proposal successfully passed the screening and assessment. The participants put forward many valuable suggestions for the revision of the proposal.

In 2007, three proposals for infrastructure construction projects for research and education submitted by CAS Kunming Branch were officially approved by the National Development and Reform Commission (NDRC). XTBG's proposal was one of them.



Mr. LI Hongwei (right 1), Deputy Director of XTBG and project manager presented the project to the expert panel from State Reform and Development Commission



XTBG research center master plan