



STUDY AND COMPARISON
OF THREE FOREST CANOPIES
IN YUNNAN (China)

Preliminary plans, Call for Contributions, July 2015

PREAMBLE

Summary

Opération Canopée is a private non-profit organisation with works regularly with governmental institutions and research centres. We aim to contribute to the study of the diversity of the fauna and flora of the canopies of humid tropical forests.

Opération Canopée associates local scientific experts with specialists of other nationalities and develops and tests air-borne techniques for access to the canopy, where biodiversity is richer than in all the other forest strata.

Depending on demand, opportunity and skills, the scientific disciplines involved are botany and ethnobotany, pharmacology, entomology, mammalogy, herpetology, ornithology, virology, medicine and climatology. Depending on the terrain and the geographic context, the scientific team is supported by specialists with other skills: aeronauts and architects, engineers, climbers, logistics experts, filmmakers and journalists.

Since the founding of Opération Canopée has set up and coordinated more than 10 expeditions in the tropics in 4 continents have been organised on the basis of this model and with active support from the authorities of the countries concerned.

Our team organised a reconnaissance in the Yunnan in April 2015 in coordination with the Chinese Academy of Sciences, the Chinese Academy of Forestry, the Xishuangbanna Tropical Botanical Garden, the Muséum d'Histoire Naturelle de Paris and the French Embassy in Beijing

During the trip, we observed that the features that are essential and indissociable for a canopy research project were present in China: quality of reception, dynamic Chinese research teams and a variety of forest sites visited.

This presentation document entitled 'Study and Comparison of 3 Forest Canopies in the Yunnan (China)' is aimed at inviting scientific, administrative and technical collaboration.

The canopy

30 to 50 metres above the ground, the canopy is the interface between the upper layer of a forest and the atmosphere. It operates as a solar receiver to enable the entire forest to function. Homogeneous and closed in primary (or intact) forests, it is destructured in secondary forests and disappears when forest degradation continues to increase. Animals feeding on these resources are also found here: molluscs and insects, batrachians and reptiles, birds and mammals. A high-energy environment, the tropical canopy focuses the greatest biological diversity in the world. This provides considerable resources for industry and research: new structures for biomimetics, substances for fine chemicals, perfume and cosmetics, active substances for pharmacy and medicine, genes for agronomy, VOCs for biology, etc. Today, all the industrialised countries are developing resources for access to tropical forest canopies.

* Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, A.B. and Kent, J. Biodiversity Hotspots for Conservation Priorities. Nature 403, 853-858, 2000.

* Mittermeier, R.A. and Robles Gil, P. (editors) Hotspots revisited, Cemex, Mexico, 390 pp., 2004.

International context

The reserves in the Yunnan in China are concerned by the Critical Ecosystem Partnership Fund (CEPF) that has identified 34 zones as being key sites for world biodiversity. These 'hotspots' are sited in only a few regions and justify substantial facilities for conservation and use.

A project in the Yunnan matches the general approach of the GSCP:

The Global Strategy for Plant Conservation is a programme of the *Convention on Biological Diversity (CBD)*

In 2010, the Conference of the Parties to the CBD, by Decision X/17, adopted the Updated Global Strategy for Plant Conservation 2011-2020. The Strategy's vision is to halt the continuing loss of plant diversity and to secure a positive, sustainable future where human activities support the diversity of plant life (including the endurance of plant genetic diversity, survival of plant species and communities and their associated habitats and ecological associations), and where in turn the diversity of plants support[s] and improve[s] our livelihoods and well-being.'

<http://www.plants2020.net/about-the-gspc>

Scientific projects:

Study and comparison of 3 forest canopies in the Yunnan (China)

1 | GENERAL CONTEXT

In line with our previous expedition in the region (to Laos) and for the period 2015-2020, we address the major scientific question: 'What is the pertinence of the study of tropical canopies for the conservation of biodiversity?'

Classic inventories based on transects often take into account only a fraction of biodiversity. They focus on trees with a trunk diameter of more than

10 cm and neglect a large proportion of biodiversity, whether this be on the ground, in the soil or in the canopy. We propose to reposition canopy biodiversity in an integrated context, making it possible to quantify biodiversity at all the 'strata' of the tropical forest ecosystem: the canopy itself and the lower 'intermediate' strata, finishing at ground level.

The project will also make it possible to ascertain whether the reputation of certain plant groups for being undetectable in traditional inventories is true. These plants—with orchids being the emblematic example—are all covered by conservation measures. Accurate evaluation of their detectability is a crucial point in any conservation policy for a given region.

2 | CHINA AND CANOPY RESEARCH

China's first International Workshop on Forest Canopy Research was held in Kunming, capital of the Yunnan, in 2006. The subjects addressed were above all related to the risks associated with climate change: carbon flows, canopy temperatures, the impact in the increase in atmospheric CO₂ on the growth of biomass, evolution of the albedo, etc. Ecotourism was mentioned, as was 'canopy farming' and the search for animals and Orchidaceae that might be beneficial for the economy.

In 2013, a crane was set up at Buben (Yunnan) and is currently used for numerous research projects.

It is impossible to protect what one does not know and so a contribution should be made to the inventory of biodiversity in the Yunnan, which houses 50% of living species in China on 4% of the area of the country. Conventional inventories using transects and concentrating on trees with a trunk diameter of more than 10 cm neglect an essential part of biodiversity - that found in canopies. Methods provided access to the treetops and allowing work to be carried out in safety will give us an opportunity to complete the inventory by completing it with the animal and plant species that live in forest canopy.

OBJECTIVES FOR 2015 - 2020





Physiological Research

1 | SYSTEMATIC BOTANY

The extremely rich flora in the Yunnan results from the combination of the following features:

- tropical or near-tropical latitudes,
- high altitudes because of the eastern Himalayas,
- moisture brought by north-south valleys, including that of the Lancang Jiang, which becomes the Mekong at the Burma-Laos frontier.

This rich flora will justify abundant harvesting and will require very special attention to the drying, packing and transport of the herbarium.

2 | ECOLOGY OF EPIPHYTES

The exceptional abundance of epiphytes justifies special studies of 'hanging gardens' and the possible role of ants in their establishment and the soils, fungi and animals associated with 'canopy roots'. There will be abundant harvest of live Orchidaceae in the canopy and a reception structure is to be planned at Xishuangbanna Botanical Gardens.

3 | PLANT ARCHITECTURE

China is right up to date in this field, as is demonstrated by the functioning of the Greenlab project at the LIAMA (Sino-European Laboratory in Computer Science, Automation and Applied Mathematics. 5F, Intelligent Building. N.95, ZhongGuanCun East Road. BEIJING, 100190). The study of 'canopy roots' will be extended by that of the reiterations that produce them; harvests will make it possible to test the possible genetic heterogeneity of these reiterations and its links with the richness of the canopy in active substances that have potential usefulness in medicine.

4 | PLANT PHYSIOLOGY

Setting up a 'Phytovason' for the Ailao Shan physiologists who use a similar device: the branch of a tree is placed in modified atmosphere and the impact on growth is measured (length, diameter, rhythms, leaf area, etc.). Use should be made of the experience of the Max Planck institute: the 'cuvettes' installed on the Treetop Raft by Andreae and Kesselmeier's team (Cameroon 1991) could be used as a basic device and improved.

5 | LANDSCAPE ECOLOGY

The sites in the Yunnan visited by Opération Canopée in 2015 revealed strongly changing landscapes. This question justifies the setting up of collaboration between the École du Paysage de Versailles and a similar establishment in China.

6 | ENTOMOLOGY

Insects form the essential part of canopy biodiversity in all the tropical forests in the world and an astronomical number of species remain to be discovered. On-going contributions.

7 | ORNITHOLOGY

On-going contributions.

8 | OTHER BIOLOGICAL DISCIPLINES

Other research was carried out during previous work by Opération Canopée and can thus be envisaged for the Yunnan: herpetology, mammalogy, biomechanics, biochemistry, bryology, mycology, lichenology, bacteriology, virology and genetics. We leave our Chinese partners to choose the range of disciplines best suited to their own requirements and to the context of the research stations in the Yunnan.

Research on equipment for access to canopies

Equipment for access to forest canopies has been tested since the founding of the association and the devices are themselves subjects for research leading to in situ experiments. On completion of the process and when the devices have proved to be operational and reliable, a special canopy access service is proposed to the scientific community within the framework of a research mission. The project entitled 'Study and comparison of 3 forest canopies in the Yunnan (China)' is in this innovative context.

THE CINEBULLE BY DANY CLEYET-MARREL

The Cinébulle has proved its worth in aerial photography and the accompaniment of scientists on the canopy for about 15 years. It can also carry and deliver objects weighing less than 100 kg. The apparatus will be modified to match the context of the project entitled 'Study and comparison of 3 forest canopies in the Yunnan (China)' and to facilitate contact with trees.

- It is planned to make the electrical propulsion system more powerful by installing two directly connected motors to be able to withstand stronger winds.
- The seat will be changed to enhance the collection of botanical or entomological samples.

THE HELIBULLE (DCM)

A 360 cubic metre helium balloon driven by two electric motors can carry two passengers. As its volume is a quarter of that of the Cinébulle for carrying the same load, it can face stronger winds. Its ease of use means that it can be operational rapidly to take advantage of all opportunities for flight.

- It can also be used for sample collection.

THE CARBORADO BY GILLES EBERSOLT

With 4 successive versions, the Treetop Raft remains an emblematic tool for access to the canopy. Priority was awarded to lighter equipment in previous projects. The project entitled 'Study and comparison of 3 forest canopies in the Yunnan (China)' has the objective of building a new Treetop Raft specifically suited to the canopies in China. For this, carbon fibre will be used as its performance is much better than the pneumatic structures used previously. The structure of the new Treetop Raft is freely inspired by a popular object seen at the market in Tenchong: the bamboo steamer basket. It is therefore planned to weave carbon fibre in a planar, circular shape. A bamboo prototype is being made at the Ecole Nationale Supérieure de Versailles (ENSA V). Placed on the canopy by the Cinébulle, the surface area can be extended in situ. Structural bracing system from the main branches of the canopy landing site.

THE PHYTOVASOTRON (GE)

This device is a combination of plastic installation and scientific data collection apparatus. The aim is to set an 'inverted container' containing the air of a specific shoot of the tree.



METHODOLOGY

Mobility objective: possible sites

The excellent welcome from the Chinese scientific community and the authorities allowed us to perform fruitful reconnaissance work in southern Yunnan in April 2015.

For reasons of the extreme variety of the sites visited, we propose to undertake comparative studies of 2 or 3 sites: one reference site and one or two other experimental sites (the list is not exhaustive and depends on reconnaissance).

1 | BUBEN CRANE SITE, VISITED ON 3 APRIL 2015

'Buben' reference site with an operational crane already has a 20-hectare referenced plot.

Access to the area is very easy.

- Programme: series of observations and mobile sampling.

- Exploration facilities: 'Cinébulle' type airlifted equipment (see details in the paragraph 'Research on equipment for access to canopies');

- Geographic position: 21°36'46.59"N 101°35'23.57"E

2 | SHANGCHANG FIELD STATION DE TERRAIN, VISITED ON 7 APRIL 2015

Located in a particularly well-preserved zone on Wu Liang Shan, this semi-mountain station (at 2500 metres) is in the heart of the forest area of great quality.

- Programme: series of observations and semi-mobile sampling, plastic and structural experiments on the canopy.- Exploration facilities: semi-mobile Treetop Raft type equipment and networking the 'Canopy Bubble' and the 'Cinébulle'.- Geographic position: 24°17'24.56"N 100°43'13.41"E

3 | DATANG FIELD STATION, VISITED ON 10 APRIL 2015

Located in the Gaoligong Shan, this village station is close to a very varied forest (with giant rhododendrons in particular).

- Programme: series of observations and mobile sampling.

- Exploration facilities: mobile equipment of the 'Canopy Bubble' and 'Cinébulle' type.

- Geographic position: 24°44'33.45"N 98°41'56.35"E

Partnerships, state of progress

The setting up of the project entitled 'Study and comparison of 3 forest canopies in the Yunnan (China)' is based on the sharing of the experience and methods used in tropical forest canopies by the scientific community.

Project management and coordination will be defined in a Franco-Chinese organisation chart covering logistics, the field team, the equipment used and the base camp.

Today, the progress of the project depends on 4 deadlines:

DEADLINE 1: October to December 2015

Identify and mobilise the institutions and scientific programmes concerned and also the Chinese and foreign partners that might participate. Set up protocols according to national sampling rules.

DEADLINE 2: January to June 2016

According to the scientific content and technical requirements, establishment of a general project budget in correlation with possible resources (national and international donors).

DEADLINE 3: June to December 2016

Field operation, combining airlift facilities and the grouped scientific community. Continuous or discontinuous programmes according to seasonal imperatives.

DEADLINE 4: The year 2017:

Use and sharing of the results

Budget

Opération Canopée is not a donor. Our mission consists of identifying funding bodies and distributing the corresponding budget. Setting up the budget and starting the search for funding: September 2015.

Past operation zones

The Opération Canopée team (in its own name or in collaboration with the NGO Pro Natura International) has already operated in numerous tropical countries involved in the study and conservation of their primary forests.

1985: first testing of the Raft on Mont Pilat

1986: first in situ test in Guiana

1989: first scientific mission to Guiana, preliminaries in Brazil

1991: forest mission in Cameroon

1996: Pronatura mission in Guiana

1999: Pronatura mission – La Makandé in Gabon

2001: Pronatura mission - Masoala in Madagascar

2004: IBISCA mission - Baro Colorado in Panama

2012: Khammouane mission in Laos

2015: Reconnaissance in southern Yunnan

Equipment developed

Opération Canopée, associated with Pro Natura International and Océan Vert, has developed various facilities for access to tropical canopies. All or part of the equipment is used depending on project configurations.

1 | THE TREETOP RAFT :

A combination of a semi-rigid bearing structure and a layer of netting in contact with the canopy. This 'upper canopy' installation is accessible to users and placed on the canopy using an aerostat.

2 | AS300 :

An 8,500 cubic metre dirigible designed specially for transporting the Treetop Raft and the Canopy Sledge is used to lift loads from the ground to the canopy.

3 | CANOPY SLEDGE :

A nacelle suspended 10 metres below the dirigible from which 3 passengers can collect samples while moving.

4 | CANOPY BUBBLE :

A 210 m³ helium balloon provides access to the canopy for one person, following a previously installed line.

5 | IKOS :

A habitable dural structure fixed by climbers in the main branches of an emerging tree. It has capacity for three users for a stay or extended observations in the canopy.

6 | CINÉBULLE :

1,500 cubic metre motorised hot-air balloon is used for reconnoitring and carrying light material. The new electrical version makes possible contact with trees and the collection of samples.

7 | CANOPY GLIDER :

A helium/hot air balloon developed with Pro Natura International for botanical and entomological collection operations on forest canopy.

8 | CANOPY STAR :

A two-seater self-stressed device in carbon fibre that is set in the canopy using the Cinébulle. Use is similar to that of Ikos.

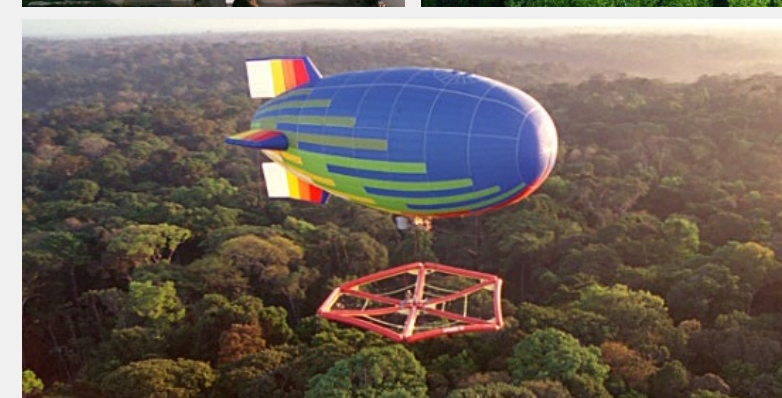
9 | NETWORK :

The Canopy Bubble provides a link between the semi-fixed apparatus (Raft, Ikos and Star) and the ground. Rapid rotations are then possible between the base camp and the canopy stations (Laos 2012).

10 | TRADITIONAL EQUIPMENT :

These eight facilities are completed by more conventional equipment such as the climbing gear used by 'tree surgeons' (ropes, ascenders, sling/pedals and carabiners), big shot line launchers to run ropes to the tops of trees, steel aerial runways, etc. A specialised team is always associated with each project for 'à la carte' collection operations..

OPÉRATION CANOPÉE, ACCESS PROVIDER



ORGANISATION

Founder members

Professor Francis Hallé, botanist, Scientific Director

Dany Cleyet-Marrel, aeronaut, designer, aerostat inventor

Gilles Ebersolt, architect, inventor of the Treetop Raft.

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