Rare Plants Protection Importance and Implementation of Measures to Avoid, Minimize or Mitigate Impacts on their Survival in Longhushan Nature Reserve, Guangxi Autonomous Region, China

Dado Toure*, J. Ellis Burnet*, Zhou Jianwei*
*China University of Geosciences (Wuhan), School of Environmental Studies
Wuhan, Hubei. 430074. Lumo Lu. P.R.China
touredado@yahoo.fr , cactais@gmail.com

Abstract: Longhushan reserve is a karst forest of very high geological and biological quality. Located in South of China, Guangxi Region, the area reflects the high diversity of Guangxi, whose biological resources are among the first in China, and which ranks first among the Chinese provinces in terms of rare plant species. The present research was undertaken to examine the ecosystems within the forest, and thus generate an awareness of the importance of rare plant species in order to stimulate the conservation role of Authorities and population. A field survey was conducted, plant species were recorded from 17 quadrats, geological and soil samples were collected to examine some of their chemical and physical characteristics significance on the vegetation formation. During the survey, 152 plant species were recorded, 35 species were found as dominant canopy and substrata species, and 12 species were identified as endangered. Within those endangered species, 6 are included in the International Union for Conservation of Nature and Natural Resources (IUCN) red list for endangered species and 3 are endemic. Analysis of geological and soil samples revealed that dolomite appears to be the factor that impacted species distribution, while rare plants and dominant species responded differently to soil type, PH, moisture and organic matter (OM) content. Which lead to say that in the reserve each karst environment is unique due to its localized conditions, geological and soil properties, land use practices, climatic conditions, hydrological and geomorphologic status. The results also pointed out the evidence of karst ecosystem fragility which makes the vegetation formation or restoration a slow and difficult process. Therefore, plant species protection especially endangered species is fundamental in the area because their conservation is central not only to biodiversity conservation but also to the preservation of karst ecosystems. [Journal of American Science 2010;6(7):221-238]. (ISSN: 1545-1003).

Key words: Rare plants protection; Longhushan; avoidance, minimization/mitigation measures; Impact.

1– Introduction

The main focus in the protection of natural areas across the globe has been in the context of preserving landscape beauty, natural heritage, unique biological habitat or recreation. China, despite of the importance of natural reserves creation, has its endangered species faced with an onslaught of threats. China contains some of the world's richest troves of biodiversity, yet the surveys of plants and animals reveal a bleak picture that has grown bleaker during the past decade. According to scientists, for plants the situation is worse: nearly 70% of all nonflowering plant species and 86% of flowering species are considered threatened (Yardley, 2007). For centuries, Chinese leaders emphasized dominance over nature rather than coexistence with it. Animals and plants are still often regarded as commodities valued for use as medicine or food, rather than as essential aspects of a natural order. The whole idea of ecology and ecosystems is a new thing in the culture. China's status as a leading center of biodiversity makes the threatened state of wildlife a global concern. Being the third largest country in the world, with the greatest population, the diversity of its topography and climate is reflected in its animals and plants species. China is one of a small handful of countries, maybe a dozen, that has a remarkably high numbers of species, and a remarkably high number of species that are not found anywhere else (Yardley, 2007). The biodiversity ranks eighth in the world, first in the northern hemisphere and an estimated 10% of the world's plant species are found within its vast expanse (Watters, et. al 2002). In large part, this high diversity is due to the variety of habitats and landscapes. But the effectiveness of provincial parks and conservation authorities in protecting endangered species varies considerably. Many places have greater emphasis on exploiting the natural environment for human enjoyment than on protecting habitats or rare plants. Longhushan Reserve is a tangible example of this type of situation. The area belongs to Guangxi which is one of the key forest areas in southern China, ranking first among the Chinese provinces in homing to the rare species of plants. About 8,354 wild plants have been found in the region, including 122 kinds which are near extinction and need special protection (Chinese Business World).

The question we are about to ask our self is why do we have to protect plants from extinction? why not let the nature take its course and allow plants to die out? There are many reasons for that. Our planet is experiencing species extinction rates unprecedented in the history (US National Academy of Science, 1995). Scientific work over recent decades has given a good understanding of the risks these extinctions pose for the planet and its human inhabitants. Science has also provided us with an understanding of the basic requirements for effective conservation of biological diversity. The main reason that many species are endangered or threatened today is because people have changed the habitats upon which these species depend. Extinction is a natural process that has occurred throughout world history, but in recent times humans have become the major threat to the survival of many plants. Technological developments and increasing pressure for agricultural land combined with the exploitation of timber, minerals and other natural resources, are causing rapid environmental changes. These threaten whole ecosystems, such as the rain forest in tropical countries. As a result, the survival of thousands of plant species is threatened (Morton, Canadian Encyclopedia).

The initial data and observation collection resulting in preliminary mapping of Longhushan reserve showed that a large proportion of the "secondary" forest on the lower mountain slope is, in fact, a plantation forest with a simple canopy structure or complex sub-strata. The transitional stage to an analog forest has not yet been reached, although there are indications that in some forest stands there is sufficient regeneration and the forest is dynamically robust to evolve in the future (Ellis Burnet, Mbue et. al 2008).

In fact, the karst mountains in Southwestern China are usually bare rock with little or no vegetation due to their low soil forming capability and their relative shortage in nutritive elements. This explains the fragility of these areas and the difficulty of restoring vegetation once destroyed. For the specific case of Longhushan, after the massive cutting of part of the natural forest for the benefit of medicinal plantation in the 1960s, the area is now almost completely covered by vegetation with plants growing through the rocks' fissures to the summit (*Figure 1*, *Figure 2*). This is the peculiarity of the area and raises our interest for the understanding of this rare ecological system and the necessity of controlling human activities for the maintenance of its ecosystems and so its endangered species. Because currently, the development of tourism activities with an uncontrolled number of primates, in addition to the continuing fragmentation of habitat through construction of small roads to facilitate tourists access to different parts of the forest, are threatening the ecological stability of Longhushan reserve which although small, but no less rich, may represent an important resource in Guangxi in terms of vegetation formation in a karst ecosystem.

Figure 1*: Longhushan reserve view from a summit/ Peak cluster depression landform*

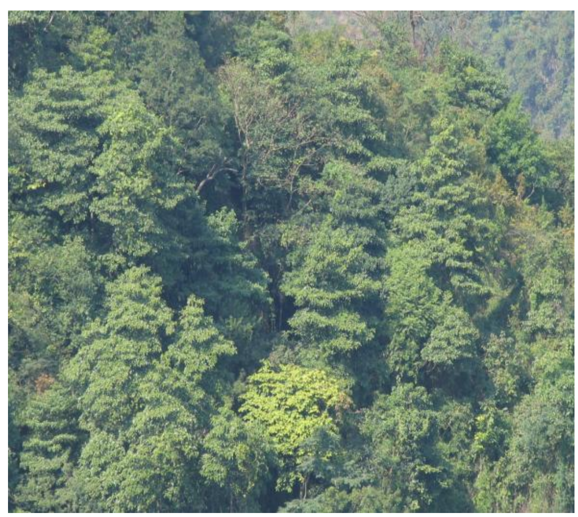

Figure 2*: Longhushan middle elevation forest*

Since the 1990's, there have been illegal activities recorded in the reserve and it is the responsibility of the protected area's administration to prevent these activities. The following illegal activities have been significant: cutting firewood 20%; poaching 30%; digging up rare or valuable plants 45%; and illegal cattle grazing (Ellis Burnet et. al 2008). Due to the various species which characterize the study area, the influence of local inhabitants who live around the reserve, the development of tourism activities, and increasing of primate population over the last 20 years (estimated to be a thousand), the site become an interesting spot and open natural laboratory to study karst forest sustainable management, botanical species, karst ecological system and the geomorphological interaction with vegetation formation.

The reserve is small but its floral biodiversity and the lack of wildlife information has lead to the belief that some aspects of its ecology are not well known, therefore need to be studied in detail, consequently, the species can be identified and protected. This study was initiated to draw attention to this small reserve with its rich biodiversity so as to greater public awareness about the importance of rare plants species in order to stimulate the conservation role of Governments, administrators and population, with the hope that publicity could prevent further habitat destruction leading to possible extinctions.

The main purposes of this study are to: (i) identify endangered or endemic plant species and their importance for biodiversity conservation, the dominant canopy and substrata species within the reserve; (ii) examine soil characteristics and their significance for the vegetation formation; and (iii) suggest avoidance, minimization, and/or mitigation measures for sensitive areas as wilderness and ecological reserves in which effective protection can be provided to any rare plants growing in them.

We hope this study will generate more scientific interest in the local area and further research will be undertaken to investigate habitat, fauna and flora of the reserve so as to generate a sustainable conservation perspective.

2. Materials and Methods

2.1. Site location and description:

The present study was conducted in Longhushan nature reserve located in South of China, Guangxi Zhuang Autonomous Region, Nanning city, Long'an County (*Figure 3*). It is approximately 36 kilometers away from the county headquarters and 90 kilometers away from Nanning city, the provincial capital. The reserve covers an area of 2255.7 hectares and is bounded between latitudes 22°56′-23°00′N and longitudes 107°27′-107°41′E. Longhushan has a monsoon climate characteristic of the subtropical zone and is influenced by the regulation of a maritime climate. It has abundant sunshine combined with high rainfall, but with little frost and no snowfall. The annual average temperature is 21.8Cº, with the annual average precipitation of 1500 mm which is mostly centralized in summer.

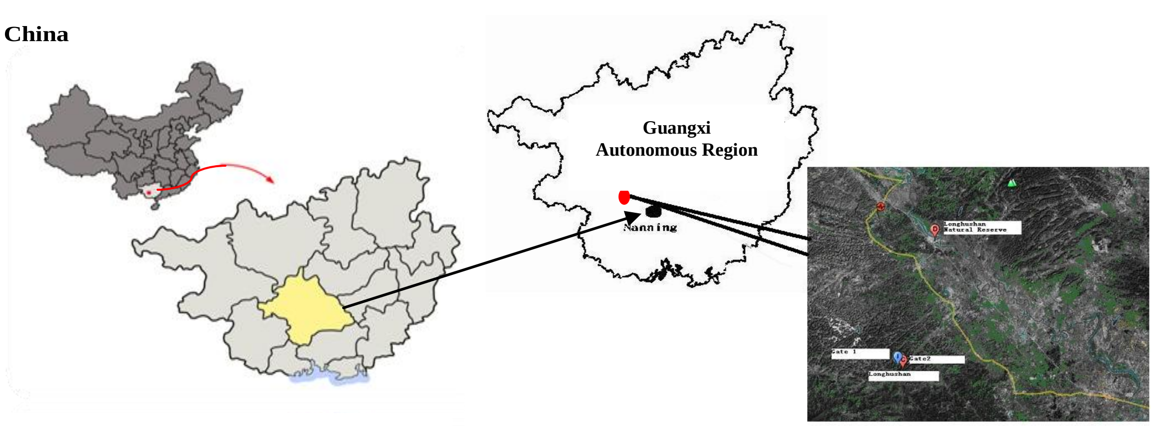

Figure 3*: Longhushan reserve location*

The reserve was established in 1980, under the administration of the Ministry of Health. Because of the significance of its medicinal herbs, it became a reserve with its present name in 1982. The Ministry of Forestry took over the administration of the reserve in 1987 in order to strengthen its protection and in November 1991 the status changed to forest and wild animal protected area.

In the reserve there is an altogether different world, with green hills, the Green River channel, karst caves, and stone forests. The protected area is a typical peak cluster depression landform and is divided into three sectors by two landscape barriers: the highway from Nanning to Daxin and the Green River (*Figure 4 and Figure 5*). There is an underpass beneath the highway linking the northern sector of the reserve which also allows the passage of precipitation run-off during intense rain events. Several bridges span the Green River linking the southern sector to the central sector. The protected area is small but the public road Nanning-Daxin running through it and dividing the park into two parts makes environmental protection difficult. The floral biodiversity is rich, about thousand plant species with different types of canopy cover and substrata species: small trees, shrubs, high trees, vines, and invasive weed species. However, it is in a karst area easily exposed to rock desertification. The fragility of the karst ecological system in tropical and subtropical regions is the basis of rock desertification, but the desertification sequences are triggered by anthropogenic impacts including population pressure, inappropriate land use policies, planning and practice.

Figure 4: ***View from a summit/*****Green river** ***passing through the reserve***

Figure 5: ***View from a summit/Highway Nanning-Daxin passing through the reserve***

2.2 Field survey and sampling methods:

In order to achieve the objectives of this study, two field surveys were conducted in Longhushan reserve, during August and November 2008. The survey was carried out using 30 meters square quadrats randomly located along north-south transects lines equidistant apart. In order to ascertain the forest stand structure, dynamic and condition in relationship to the parent geology, soils, human and primate impact on the synecology of the forests. Data was collected from 17 quadrats refer to as X1, X2,………X17 along 4 transect lines: geological samples (surface rocks) and soil samples were collected from each quadrat for chemical analysis. Dominant canopy and sub-strata species were recorded and botanical samples also were collected for identification. All samples were recorded on the day of collection in a Field Register and all data recorded were logged into a computer base using Excel and SPSS programs. The geological samples were collected from the surface of each quadrat, while the soil samples were collected from the topsoil layer (0–10 cm) after removal of leaf litter. A total of 17 surface soil and geological samples were collected for analysis and both geological and soil samples were bagged separately in clean zip-lock plastic bags and labeled.

In addition to the systematic sampling, the opportunity was also taken throughout the survey for empirical observation and talk to local people in order to get their thoughts about the area, obtain more information about the Reserve's management, human activities and their impact on the reserve, the reserve's environmental protection and sustainable use.

2.3 Analysis

The botanical specimens were identified within two weeks of collection in the South China Herbarium, Nanning-Guangxi and were preserved for future reference. The botanical nomenclature of the South China Institute of Botany (1987, 1991, and 1995) was adopted. All botanical samples were identified in Guangxi Botanic Garden. The status of rare plant species were established by illustrated handbooks of Guangxi vegetation and China high vegetation, as well as the Red Book. The endangered species list published by Chinese Government was also referenced. In order to know the nature of parent rock and its relation with vegetation, geological samples were analyzed for the percentage of calcite and dolomite while the soil samples were tested for their texture, moisture, PH, and OM content so as to examine the soil properties and their significance on vegetation formation. To determine dolomite and calcite content in the geological samples, HCl was used on the samples to define dolomite and calcite by the naked eye and alizarin-red used to determine them using microscopic observation. Soil moisture content was obtained using the standard oven-dry method calculated from soil sample weights before and after drying and expressed as a percentage of the mass of the oven-dried soil. Soil-water suspension method was used to test soil PH. For OM content, the classic dichromate wet oxidation method for the determination of organic carbon in soils was used. To examine soil type for its physical characteristic, the United State Department of Agriculture (USDA) method was used to determine soil textural classes based on percentage content of sand, silt, and clay.

3. Results

During the survey, from the 17 quadrats studied, 152 plant species were identified, among them 35 species were found as dominant canopy and substrata species, and 12 species were identified as endangered in 8 quadrats (X1, X2, X3, X4, X6, X14, X16, and X17).

3.1. Rare plant species

Within the 12 endangered species recorded, 6 are included in the IUCN Red List for endangered species, 3 are endemic. The following table (*Table1*) shows the list of rare plant species recorded with their botanical taxonomy.

Table 1: Rare plant species identified in Longhushan Reserve

N°	Location	Scientific name	Status	Phylum	Class	Order	Familly
1	T1 QIV	***Burretiodendron tonkinense* (Gagnep.)Kosterm**	Endangered (IUCN red list)	Tracheophyta	Magnoliopsida	Malvales	Tiliaceae
2	T1 QII; T1 QIII	***Camellia pubipetala* Y.Wan & S.Z.Huang**	vulnerable (IUCN red list)/ ***Endemic***	Magnoliophyta	Magnoliopsida	Malpighiales	Theaceae
3	T4 QIII	***Canthium dicoccum* (Gaertn.) Teijsm. & Binn**	Vulnerable (IUCN red list)	Tracheophyta	Magnoliopsida	Rubiales	Rubiaceae
4	T1 QI	***Desmos chinensis* Lour**	Locally endangered	Magnoliophyta	Magnoliopsida	Magnoliales	Annonaceae
5	T1 QII; T1 QIII	***Garcinia paucinervis* Chun & How**	Endangered (IUCN red list)	Tracheophyta	Magnoliopsida	Hypericales	Clusiaceae
6	T2 QII	***Habenaria ciliolaris* Kraenzl**	Locally endangered	Magnoliophyta	Liliopsida	Asparagales	Orchidaceae
7	T4 QIV	***Hainania trichosperma* Merrill**	***Endemic***	Tracheophyta	Magnoliopsida	Malvales	Tiliaceae
8	T4 QIII	***Hartia sinensis* Dunn**	Locally endangered	Magnoliophyta	Magnoliopsida	Theales	Theaceae
9	T1 QII; T1 QIII	***Machilus salicina* Hance**	Locally endangered	Magnoliophyta	Magnoliopsida	Laurales	Lauraceae
10	T4 QI	***Malania oleifera* Chun et S.Lee**	Vulnerable (IUCN red list)/ ***Endemic***	Tracheophyta	Magnoliopsida	Santalales	Olacaceae
11	T2 QII	***Mallotus philippinensis* Mull.-Arg**	Locally endangered	Magnoliophyta	Magnoliopsida	Euphorbiales	Euphorbiaceae
12	T2 QII	***Zenia insignis* Chun**	Near threatened (IUCN red list)	Tracheophyta	Magnoliopsida	Fabales	Fabaceae

Burretiodendron tonkinense (Gagnep.) Kosterm*:* is a species of flowering plant native in China (Guangxi, Yunnan) and Vietnam extending from southern China to northern Vietnam. The species is confined to forest in limestone areas and considerable population declines have been observed. It is *endangered A1d ver 2.3* (IUCN red list) threatened by habitat loss, overexploitation of the timber and lack of sufficient regeneration.

Camellia pubipetala Y.Wan & S.Z.Huang: species of shrub or small tree, known from two locations, Long'an and Daxin in China (Guangxi), *endemic* to China. This species occurs in evergreen broadleaved forest at the base of limestone mountains, between 190 and 230 m. It is *vulnerable B1+2c, D2 ver 2.3* (IUCN red list), threatened by constant threats of cutting and habitat clearance.

Canthium dicoccum (Gaertn.) Teijsm. & Binn*:* also called “Ceylon box wood” in English, is a species of plant native in Sri Lanka. It is also found in tropical South Asia and Southeast Asia. This is a species of shrubs or trees restricted to lowland wet evergreen forest. It is *vulnerable A1c ver 2.3* (IUCN red list).

Desmos chinensis Lour*:* called “Dwarf Ylang Ylang Shrub” is a climbing shrub with straggling branches, up to 5 m tall. Its distribution is throughout Nepal, Eastern India, Burma (Myanmar), Indo-China, southern China, Thailand, Peninsular Malaysia, Sumatra, Java, Borneo and the Philippines. It occurs in open locations and borders of lowland forest. It is also found in living fences and brushwood, up to 600 m altitude. The plant is used as a folk medicine in China for the treatment of malaria and of dysentery, parturition and vertigo.

Garcinia paucinervis Chun & How*:* is a species of flowering plant native in China (Guangxi, Yunnan) and Viet Nam. The populations are confined to central Guangxi and to Malipo in south-east Yunnan, extending into northern Viet Nam, distributed in forest on limestone, rarely above 600 m. This is a valuable timber species but is *Endangered B1+2e ver 2.3* (IUCN red list) threatened by habitat loss, cutting of large trees; very few remain and regeneration also appears to be insufficient. This species is vulnerable to extirpation because of its restricted and scattered distribution, overcutting, and poor seed germination and natural reproduction. The wood is hard, heavy, and extremely water-tolerant. It is used for shipbuilding, construction, quality furniture, and in the military industry.

Habenaria ciliolaris Kraenzl : is a terrestrial plant 30 to 50 cm tall on forest floor with rich humus, shaded places in forests or along valleys with forest trails at low to mid elevations; it is distributed from South East China to Vietnam and Taiwan.

Hainania trichosperma Merrill: is a species of tropical plant, up to 15m tall; native in Hainan, Guangxi and Yunnan in China. It is *endemic* to China and is light-demanding and drought resistant, adapts to limestone soil and acid soil. It is also a fairly good tree species for afforestation on limestone hill area or barren hills in Hainan and southern Guangxi.

Hartia sinensis Dunn*:* species of tree or shrub, 6–15 m tall, evergreen found in China (Sichuan, Yunnan, Guizhou, Guangxi, Guangdong, Hunan, and Jiangxi). It is located in woodland rich clay soil, must have high humidity and semi shade.

Machilus salicina Hance*:* is a medicinal plant species, usually 3-5 m tall located in stream sides and riversides of low elevations; it grows well on river banks and can be used to protect the bank from flooding. It is found in China (Guangdong, Guangxi, S Guizhou, Hainan, S Yunnan), Cambodia, Laos, and Vietnam.

Malania oleifera Chun et S.Lee*:* is a species of plant, native in China (Guangxi, Yunnan), scattered in western Guangxi and eastern Yunnan. It is *endemic* to China and the genus is monotypic. It is found in tropical and warm-temperate regions, confined to limestone mountains up to 1,640 m. It is *Vulnerable B1+2c ver 2.3* (IUCN red list 2006) threatened by habitat loss. Wild populations are much reduced as a result of continued logging and habitat clearance.

Mallotus philippinensis Mull.-Arg*:* or “Kamala” tree in English is a species of tree locally common in shrub land and young secondary forest. It is found throughout tropical regions: China (Sichuan, Yunnan, Guizhou, Hubei, Hunan, Jiangxi, Anhui, Jiangsu, Zhejiang, Fujian, Taiwan, Guangxi, Guangdong, Hainan), S & SE Asia, and tropical Australia. It is used for industrial oil, dyeing silk and wool, also for medicine. In India, the increasing demand of natural dyes has attracted the attention of herb traders towards this common but useful herb. This demand can create the pressure on natural population.

Zenia insignis Chun: is a species of plant native from China (Guangdong, Guangxi, Guizhou, Hunan, Yunnan) and Viet Nam, concentrated in limestone areas at low elevation. The subpopulations are widespread throughout southern China and in several of the northern provinces of Viet Nam. It is the only member of the genus. This species is classed *lower Risk/near threatened ver 2.3* (IUCN red list) but it is threatened by habitat loss. In China constant overcutting of the tree and its habitat has resulted in the species becoming scarce.

3.2. Dominant canopy and sub-strata species

Among the 35 dominant species identified, 19 were dominant canopy and the rest were found as dominant substrata species (*Table2*).

Table 2: Identified dominant canopy and sub-strata species in Longhushan Reserve

N°	Scientific Name	dominant	Location
1	***Aesculus chinensis***	canopy	T4 QI
2	***Albizia chinensis***	can: s-st	T2 QIV; T3 QIII; T3 QIV; T3 QII
3	***Ardisia brunnescens***	sub-strata	T1 QI; T2 QIII; T1 QIII; T1 QIV; Qca
4	***Ardisia depressa***	sub-strata	T2 QII; T3 QI; T3 QIV; T4 QIV
5	***Ardisia virens***	sub-strata	T3 QII; T4 QII OOL
6	***Bischofia javanica***	canopy	T3 QIII; T2 QI; T2 QII; T3 QI
7	***Breynia fruticosa***	sub-strata	T1 QII
8	***Boehmeria Macrophylla***	sub-strata	T2 QIV
9	***Castanopsis indica***	canopy	T1 QI
10	***Clausena excavata***	sub-strata	T1 QII; T1 QIII; T1 QIV; T2 QII;
11	***Cleistocalyx operculatus***	can; s-st	T1 QII; T1 QIII
12	***Croton cavaleriei***	can: s-st	T2 QIII; T1 QII
13	***Eurya groffii***	sub-strata	T4 QIII
14	***Hainania trichosperma***	canopy	T4 QIV
15	***Laportea violacea***	sub-strata	T1 QII
16	***Ligustrum lucidum***	sub-strata	T4 QII
17	***Liquidamber formosana***	canopy	T4 QI; T2 QI
18	***Machilus salinina***	can: s-st	T1 QII; T1 QIII
19	***Maesa balansae***	sub-strata	T2 QI; T3 QI
20	***Maesa japonica***	sub-strata	T3 QI; T4 QI; T4 QII
21	***Millettia walkei***	sub-strata	T1 QI
22	***Phlogancanthus curviflorus***	canopy	T4 QII
23	***Pithecellobium clypearia***	canopy	T1 QI; T2 QIII
24	***Pomocarpus tumatus***	canopy	Qca
25	***Psychotria rubra***	sub-strata	T1 QI; T2 QIV; T4 QI; T4 QII; out of line
26	***Pyrus calleryana***	sub-strata	T2 QII; T2 QIII; Qca
27	***Rubus leucanthus***	sub-strata	T2 QI
28	***Saraca chinensis***	canopy	T1 QIII
29	***Sterculia euosma***	canopy	T4 QIII
30	***Sterculia lanceolata***	canopy	T2 QIV; T2 QIII; Qca
31	***Sterculia nobilis***	canopy	T4 QII; T3 QII; T1 QI; T2 QIII; T1 QIII; T1 QIV; T3 QI; T3 QIV
32	***Syzgium jambus***	canopy	T1 QIV
33	***Teonongia tonkinensis***	can: s-st	T3 QIV; T4 QIII; out of line
34	***Wendlandia uvarifolia***	canopy	T1 QIII
35	***Zanthoxylum dissitum***	sub-strata	T3 QIII

Of the 19 dominant canopy trees recorded in Longhushan Reserve, *Sterculia nobilis* (Noble Bottle Tree) was the highest occurring species being dominant in eight quadrats. It has medicinal properties and the wood is hard making is suitable for furniture products. The tree is rich in resin which is used as an industrial material. *Sterculia nobilis* is shade tolerant, easily grown from branch cuttings and fast growing. It develops a broad crown of beautiful shape. For these reasons it is apparent that it was a preferred plantation species used in the rehabilitation of cultivation terraces.

The second most prevalent canopy species was *Bischofia javanica*, which was recorded in four quadrats. It is commonly called the java cedar or Bishop Wood and can be found naturally in temperate and tropical regions of Asia and the Pacific Islands. *Bischofia javanica* is an evergreen tree commonly growing to between 12 – 18 meters in height. It is fast-growing from seed or cuttings, thriving best in moist soil. The leaves can be deciduous in times of drought. It also suckers from the roots making it an invasive species.

Albizia chinensis commonly known as the silk tree, occurred as the dominant canopy tree in three quadrats surrounding the Tourist Square area. It is a useful shade tree and reforestation species and also has a timber value. It is native to the temperate regions of southern China and tropical areas of the Indian sub-continent and South-east Asia. It is a deciduous species, can grow in the forest and in the field, but grows best near streams and in the valley. Its bark can be used as a traditional Chinese herb.

Sterculia lanceolata, *Liquidamber formosana*, *Pithercellobium clypearia*, *Cleistocalyx operculatus*, *Machilus salinina*, *Croton cavaleriei*, and *Teonongia tonkinensis* were found as dominant canopy in two quadrats. Although these species occurred as dominant in two quadrats, the most prevalent among them were the first four species. *Sterculia lanceolata* usually grows near streams and is native to southern China. It is considered the most widely distributed member of the genus *Sterculia*, the leaves have medicinal properties, but also can used as fiber and the seed can be eaten and extracted oil used to produce soap. *Liquidamber formosana* is a deciduous cone-shaped tree with star shaped leaves which can reach 40 m in height. It is dark green during summer but becomes ornamental in a blaze of orange and red during autumn. The wood is used for furniture, interior finish, paper pulp, veneers and baskets of all kinds. *Pithercellobium clypearia* also known as *Archidendron clypearia* is a species known for its medicinal properties. It has also been widely used in forest rehabilitation schemes to provide structure as a nitrogen fixing legume. Its bark contains tannin which can be extracted. It can be used as a host plant for the lac insect to produce lac and has a timber value. *Cleistocalyx operculatus* is a species of herb commonly used as an ingredient for tonic drinks in southern China. It is reported that cleistocalyx operculatus extracts can improve cardiac contraction through inhibiting the activity of Na+/K+-ATPase, and decrease rate of contraction.

Syzgium jambus, *Aesculus chinensis*, *Castanopsis indica*, *Hainania trichosperma*, *Phlogancanthus curviflorus*, *Saraca chinensis*, *Sterculia euosma*, and *Wendlandia uvarifolia* occurred in one quadrat as dominant canopy. *Syzygium jambus* was predominant and is a fast growing tree which grows and crops abundantly in most subtropics conditions. Various parts of the tree are used in traditional medicine, and some have in fact been shown to possess antibiotic activity. The wood is reddish, hard and grows to dimensions large enough for construction purposes. This plant is attractive to bees, butterflies and/or birds. This plant can be quite invasive in areas where it has been introduced and is a threat to several ecosystems.

Twenty one dominant sub-strata species were recorded and the most prevalent were four species: *Psychotria rubra*, *Clausena excavate*, *Ardisia brunnescens*, and *Ardisia depressa*. The first three species have all medicinal properties and were found as dominant substrata in four quadrats.

Ardisia virens, and *Maesa japonica* occurred as dominant substrata species in three quadrats. *Ardisia virens* is a species of dense evergreen broad-leaved forests, hillsides, dark damp places, valleys, humus-rich soils; 300-2700 m. *Maesa japonica* is a species of plant 1 to 5 m height. The newborn leaves can be taken as tea and the leaves are employed in traditional Chinese medicine to cure seven-year itch.

Maesa balansae, and *Pyrus calleryana* were recorded in two quadrats as dominant substrata. *Pyrus calleryana* is a tree which can reach 30-50 ft (9-15.2 m) in height and *Maesa balansae* is an important medicinal plant in the treatment of tropical disease.

The remaining species were recorded only once as a dominant sub-strata species.

3.3. Geological and soil properties

3.3.1. Geological characteristics:

Dolomite and calcite content of surface rocks collected in each quadrats are presented in *table 3*. It appears that dolomite was dominant in 9 samples ranging from 70 to 98% and representing 60% of the samples plots.

So, according to the obtained results 60% of the surveyed area has high dolomite content and 53.33% has dolomite content ≥90%, which lead us to say that dolomite is prevalent in the area. This could mean that considering the surveyed plots, the bedrock although carbonate is more dolomitic than calcitic.

Table 3: Calcite and dolomite rate of geological samples

Quadrat	Location	Calcite	Dolomite
X1	T1 QI	<2%	>98%
X2	T1 QII	n/d	n/d
X3	T1 QIII	>90%	<10%
X4	T1 QIV	>90%	<10%
X5	T2 QI	>85%	<15%
X6	T2 QII	30%	70%
X7	T2 QIII	<5%	>95%
X8	T2 QIV	<5%	>95%
X9	T2 QV	>90%	<10%
X10	T3 QI	2%	98%
X11	T3 QII	70%	30%
X12	T3 QIII	<2%	>98%
X13	T3 QIV	10%	90%
X14	T4QI	n/d	n/d
X15	T4 QII	<2%	>98%
X16	T4 QIII	10%	90%
X17	T4 QIV	90%	10%

3.3.2. Soil characteristics:

a. Soil type

*S*oil types for the 17 samples collected in Longhushan are presented in *Table 4*. Considering the USDA soil texture classification system and the results revealed by the analysis, the soil texture obtained in the area could be classified as: ***coarse*** in 1 quadrat, ***moderately coarse*** in 3 quadrats, ***medium*** in 5 quadrats and ***fine*** in 7 quadrats. So, the soil appears to be fine textured in 43.75% of the surveyed plots, medium textured in 31.25%, moderately coarse textured in 18.75% and coarse textured in 6.25%. Which means in most of the investigated site the soil tends to be from fine to medium textured although the percentage of coarse and moderately coarse texture is not negligible.

Table 4: Soil texture

Quadrat	Location	Sand (%)	Silt (%)	Clay (%)	Soil type
X1	T1QI	66.67	20.00	13.33	Sandy loams
X2	T1QII	39.29	39.29	21.42	Loam
X3	T1QIII	65.38	26.92	7.69	Loamy sand
X4	T1QIV	28.00	32.00	40.00	Clay/clay loam
X5	T2QI	23.33	40.00	36.67	Clay loam
X6	T2QII	36.36	36.36	27.27	Clay loam
X7	T2QIII				
X8	T2QIV	25	53.12	21.88	Silt loam
X9	T2QV	57.14	21.43	21.43	Sandy clay loam
X10	T3QI	33	56	11	Silt loam
X11	T3QII	50.00	42.86	7.14	Sandy loam
X12	T3QIII	35.29	29.42	35.29	Clay loam
X13	T3QIV	20.69	34.48	44.83	Clay
	Qca ①	71.43	25.51	3.06	Loamy sands
	Qca ②	45.16	38.71	16.13	Loam
X14	T4QI	28.12	46.87	25.01	Clay loam
X15	T4QII	48.39	32.26	19.35	Loam
X16	T4QIII	48.00	32.00	20.00	Loam
X17	T4QIV	55.28	35.52	12.20	Sandy loams

b. Soil chemical characteristics

Some chemical properties of the surface soils at the sample sites are presented in *Table 5*. The analysis shows that the soil PH values in the surveyed plots tend to be from *near neutral* in 5 quadrats (ranging from 6.66 to 7.46) representing 29.41% of the studied plots, to *moderately alkaline* in 10 quadrats (ranging from 7.57 to 7.91) representing 58.82% of the surveyed plots. Except for 2 quadrats representing 11.76% of the studied area and which have the PH *moderately acidic* (ranging from 5.25 to 5.71). The moisture and OM content also varied from quadrat to quadrat. The variation of these 3 characteristics per quadrat is presented in *Figure 6*. The OM content varied from 2.35% to 12.51%. Unlike PH and moisture content, there is no simple interpretation for soil OM levels as the necessary amount for plant varies depending on other factors like soil texture. But according to Hartz, (2007) who considered as high OM, soil with OM content >5%, we could say that of the surveyed plots 52.94% have high OM content (more than 5%) and 47.06% have low organic matter content (less than 5%). The moisture content varied from 14.14% to 57.49%. Despite of the fact that the soils in the quadrats are mostly fine or medium textured and the samples were taken in the very raining season, the moisture content of most of the samples was less than 50%; except for 2 quadrats which also appears to have 2 of the 3 highest OM content. So, according to the obtained data and using the soil moisture interpretation chart adapted from Harris and Coppock (1991), 88.23% of the sampled plots have *not enough available moisture* (50% or less) and 11.76% of the plots have *enough available moisture* (50 to 75%). The results also revealed that mostly high values of OM content corresponded with high values of moisture content and low values of OM corresponded with low values of moisture. In addition, coarse textured soil (ex. loamy sand) corresponded with lowest moisture and OM content. This means the moisture content and soil texture are correlated with the OM content and have impact on it; but its quantity could depend on other factors including the available dead material and the intensity of microbial activity.

Table 5: Soil moisture, PH, and organic matters content

Quadrat	Location	%Moisture content	PH	%Organic Matters
X1	T1QI	29.82	6.66	9.88
X2	T1QII	23.53	7.21	4.14
X3	T1QIII	14.14	6.67	2.84
X4	T1QIV	42.44	7.46	8.02
X5	T2QI	45.03	7.58	8.77
X6	T2QII	47.57	7.80	8.95
X7	T2QIII	23.65	5.25	4.45
X8	T2QIV	29.21	7.80	2.35
X9	T2QV	49.65	7.83	12.51
X10	T3QI	57.49	7.67	11.82
X11	T3QII	42.64	7.91	4.81
X12	T3QIII	35.32	7.41	6.80
X13	T3QIV	41.45	7.91	4.75
X14	T4QI	54.65	7.57	11.77
X15	T4QII	40.11	5.71	4.67
X16	T4QIII	30.70	7.87	4.36
X17	T4QIV	40.80	7.70	9.91

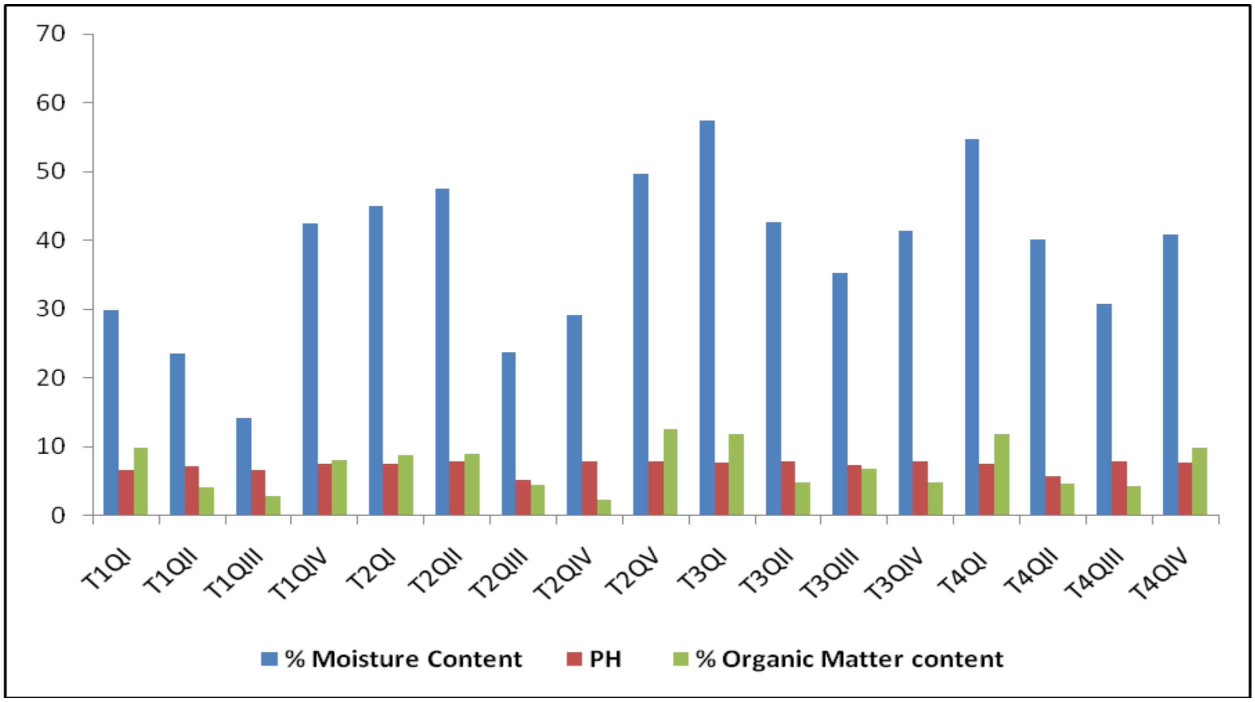

Figure 6: Three (3) chemical properties of surface soil from each quadrat

4. Discussion

4.1 Geological and soil characteristics significance for vegetation

The physical and chemical characteristics of karst geology and soil are of importance for plants species from the viewpoint of the karst ecosystem changeability. Analysis of 5 factors related to dolomite and calcite content, soil texture, moisture, OM content and PH, revealed some qualities of Longhushan soils upon which plants species depend. Maintaining these soil qualities in good conditions are important in the conservation of habitats and rare plants, because it was proved that soils have taken important role in karst processes and karst ecosystem (Li et al. 2004). According to the botanical species studied and the properties examined, it appears that the habitats in the quadrats are different depending on several factors including geological and ecological factors. Dolomite seems to be the factor that has some effect on species distribution. Because from the dominant canopy species identified, *Castanopsis indica*, *Pithecellobium clypearia*, *Sterculia lanceolata*, *Teonongia tonkinensis*, *Phlogancanthus curviflorus*, and *Sterculia euosma* were apt to live only in a high dolomite percentage; while *Cleistocalyx operculatus*, *Machilus salinina*, *Saraca chinensis, Wendlandia uvarifolia, Aesculus chinensis, Syzgium jambus*, *Liquidamber formosana* and *Hainania trichosperma* were apt to grow in a low dolomite percentage; although *Sterculia nobilis, Croton cavaleriei*, *Bischofia javanica*, *Albizia chinensis* were adapted in both situation (*table 3, table 6*). Also from the rare plant species collected, *Desmos chinensis, Habenaria ciliolaris, Mallotus philippinensis*, *Zenia insignis*, *Canthium dicoccum* and *Hartia sinensis* were found in a high dolomite percentage while *Camellia pubipetala*, *Garcinia paucinervis*, *Machilus salicina*, *Burretiodendron tonkinense*, *Malania oleifera* and *Hainania trichosperma* were collected in a low dolomite area.

On the other hand, dominant species and rare plants seem to have different response to the soil type, PH, moisture and OM content. But the suitability for plants of one characteristic in a quadrat may depend on other factors because all characteristics have correlation at some levels and impact plants' nutrients uptake. *Fine* and *medium* textured soil represent 75% of the studied area and *near neutral* to *moderately alkaline* PH represent 88.23%. The PH values classified as *near neutral* (for 5 quadrats) could be considered as the best conditions because in general, it is suitable for most plant and microbial species. While the quadrats with soil PH values *moderately acidic* (2quadrats) and *moderately alkaline* (10 quadrats) which represent both 70.58% of the surveyed plots may be subject to some nutrient deficiencies. In fact the significance of soil PH lies in its influence on nutrient availability for plants, cation exchange capacity, biological activities and on the solubility of toxic nutrient elements in soil. In extreme cases (strongly acidic or alkaline) toxic materials normally not available to plants become uptakeable. Also at high PH values, Phosphorus and most micronutrients tend to be less available in soil while at low PH values it is the macronutrients which tend to be less available.

Soil varied in texture from fine to coarse but fine and medium textured soil being dominant could be considered as good up to a point. Because as the relative percentages of silt and/or clay particles become greater, properties of soils are increasingly affected. From *Table4 and Table5*, mostly finer-textured soils contain more OM, and have higher moisture content while sandy soils tend to be low in ability to retain moisture and OM content; which confirms the claims of Rasmussen and Collins (1991). However, when soils are so fine-textured as to be classified as clayey (which is the case for 6 quadrats), they are likely to exhibit properties which are somewhat difficult for plant to endure or overcome. Such soils have usually drainage problem and could be often too moist when wet or too dry when not for nutrient availability for plants; OM could play an important role in this kind of situation.

Despite of the high percentage of fine and medium textured soil and the sampling season, the moisture content was not very important in most of the quadrats which may be due to several other factors not examined in this study including canopy cover, ground cover, temperature, soil structure, elevation, slope… This means in the dry season, most of these species with the related microorganisms could suffer from a high water shortage. In *Table 5* and *figure 6*, mostly high moisture content corresponding with high OM content could mean that moisture has some effect on soil microorganism's activity, so on the amount of OM. Also from the 8 quadrats where rare plants were recorded, only 1 quadrat X14 had moisture content more than 50% (*enough available water*) and in this quadrat is located 1 rare plant (*Malania oleifera).* All the other 11 endangered species were collected in 7 quadrats which have *not enough available water* (*table5 and table6*). From the dominant canopy species, only 3 species were collected in plots with *enough available water*, the remaining dominant species were all located in *not enough available water* condition (*table5 and table6*). However, soil moisture is of primary importance because it impacts in general the distribution and growth of vegetation, soil aeration, soil microbial activity, soil erosion, the concentration of toxic substances, and the movement of nutrients in the soil to the roots.

The OM content varied from coarse to fine textured soils and was somewhat important according to the results. It appears that more than 50% of the studied area has a high level of OM, although the 47.06% which has a low level is not negligible. Because as the level of OM is reduced below 5 percent, many of the soil's natural and beneficial functions begin to diminish. Soils with very low OM cannot support the populations of beneficial organisms needed for very important functions that both feed and protect plants. The amount could be influenced by all soil forming factors like climate, vegetation, parent material, topography, age (Jenny, 1941). Soil OM also increases with increasing precipitation and decreases with increasing temperature; the benefits of higher soil OM and associated soil fauna are often mentioned in association with good soil: increased soil aggregation, improved drainage in fine textured soils, better water-holding capacity in sandy soils, higher cation exchange capacity, increased nutrient reserves, etc. This is an important soil characteristic in karst ecosystem as it appears to be the factor that could improve other properties like texture, moisture and PH for a good quality of soil or nutrient availability for plants growth. It is necessary to improve or protect conditions to maintain high levels of OM in the reserve because soil organic matter is a huge reserve of plants and microorganisms nutrients. Plant residues that cover the soil surface also protect the soil from sealing and crusting by raindrop impact, thereby enhancing rainwater infiltration and reducing runoff. The less the soil is covered with vegetation, mulches, crop residues, etc., the more the soil is exposed to the impact of raindrops; and increased soil cover reduces the impact of rain drops to the soil which results in reduced soil erosion rates very important in South China Karst areas. This is generally due to human encroachment (i.e. tourism), inappropriate land management, forest clearance, digging up plants, etc resulting in vegetation and soil loss. In fact in the reserve, anthropogenic impact was most important in 5 quadrats: X1, X5, X7, X14 and X15 and the OM content especially in X7 and X15 was among the low values. Quadrats X1, X5 and X7 were disturbed by primate behavior and tourist pressure, X15 was only disturbed by tourist behavior while X14 was disturbed by former plantation activities. These plots were located at low elevation and near the highway under passway and 2 of them (X1, X14) contain 2 endangered species respectively *Desmos chinensis* and *Malania oleifera* which is endemic and figures in the Red List. From the empirical observation based on former and recent studies, the greatest percentage of karst tropical secondary forest species in the reserve was at the advanced regrowth stage (Zang, 2008). But karst geochemical background is known to impact the release of some mineral nutrient elements in soil, so it is suggested that some mineral elements are deficient or less available in limestone soils for plant growth (Jianhua et. al 2004). Considering this fact in addition to the soil properties, we could say that vegetation formation or restoration may be a slow process in the area. The plant communities in general look evergreen with delimitation between arbor layers, shrubs and grasses. But anthropogenic and natural forces have influenced the severity of disturbance events and the rate and mode of recovery processes within the forests. This was confirmed by Jianhua et. al (2004) in a study on karst ecosystem of Guangxi region who stated that: "without anthropogenic disturbance, the vegetation evolution is commonly from grass community, grass-bush community to arbor community. Therefore, it is suggested that the vegetation development constrained by the karst geological setting in Guangxi Zhuang Autonomous Region. i.e. it implies the plant growth and community evolution is slower in karst area than that in non-karst area".

Table 6: Dominant canopy species for the location of the rare plant species

Quadrat	Location	Rare plant species	Dominant canopy species
X1	T1QI	*Desmos chinensis*	*Castanopsis indica* *Pithecellobium clypearia* *Sterculia nobilis*
X2	T1QII	*Camellia pubipetala* *Garcinia paucinervis* *Machilus salicina*	*Cleistocalyx operculatus* *Croton cavaleriei* *Machilus salinina*
X3	T1QIII	*Camellia pubipetala* *Garcinia paucinervis* *Machilus salicina*	*Cleistocalyx operculatus* *Machilus salinina* *Saraca chinensis* *Sterculia nobilis* *Wendlandia uvarifolia*
X4	T1QIV	*Burretiodendron tonkinense*	*Aesculus chinensis* *Sterculia nobilis* *Syzgium jambus*
X5	T2QI	-	*Bischofia javanica* *Liquidamber formosana*
X6	T2QII	*Habenaria ciliolaris* *Mallotus philippinensis* *Zenia insignis*	*Bischofia javanica*
X7	T2QIII	-	*Croton cavaleriei* *Pithecellobium clypearia* *Sterculia lanceolata* *Sterculia nobilis*
X8	T2QIV	-	*Albizia chinensis* *Sterculia lanceolata*
X9	T2QV	-	
X10	T3QI	-	*Bischofia javanica* *Sterculia nobilis*
X11	T3QII	-	*Albizia chinensis* *Sterculia nobilis*
X12	T3QIII	-	*Albizia chinensis* *Bischofia javanica*
X13	T3QIV	-	*Albizia chinensis* *Sterculia nobilis* *Teonongia tonkinensis*
X14	T4QI	*Malania oleifera*	*Liquidamber formosana*
X15	T4QII	-	*Phlogancanthus curviflorus* *Sterculia nobilis*
X16	T4QIII	*Canthium dicoccum* *Hartia sinensis*	*Sterculia euosma* *Teonongia tonkinensis*
X17	T4QIV	*Hainania trichosperma*	*Hainania trichosperma*

4.2 Importance of rare plant species protection in Longhushan reserve:

To talk about rare plant species importance in Longhushan, it is relevant to insist on the benefit of plants in general in this area because these endangered plants are important not only as species at risk of being lost but also as plant species in an environmental fragile system. In general, in covered karst the vegetation covers the limestone. This has two important effects on the geology: vegetation produces CO_2 in the earth, which fastens the corrosion (dissolution) of limestone. The growth of caves is faster than in bare karst. On the other hand, the vegetation covers the limestone from the air, so there is much less erosion depending on weather.

Plants are also essential to wildlife because all living species, including people, depend on other species for survival. Other than the plant species in Longhushan, faunal assemblage was dominated by the primate, Rhesus macaque or *Macaca mulatta* a near threatened species whose home range is determined by the quality of vegetation and the rhesus population density (Jiang et. al 1991). But also several different species of snail, snake, butterflies, spiders, worms, birds, insects,… were observed. Through mutual adaptation, plants meet the exact food and shelter needs of wildlife and wildlife-plant relationships are often extremely specialized.

Plants are essential to ecosystem function in the reserve because they build soil which is deficient in karst areas, then soil stores water and mediate floods (Daily et. al 1997). Soil produces the foods we eat and the commodities we use (Mueller et. al 1974), as karst soils are known with a low productivity and the local population in the area very poor. Plants help ecosystems reduce flooding by facilitating water infiltration into soil, reducing runoff, and through absorbing and transpiring water (Wilson et. al 2001). Plant roots, shoots, and foliage also reduce erosion by holding soil in place and softening raindrop impact (Myers, 1997) which also might be a very important factor in karst area for the prevention of rock desertification.

Plants produce valuable commodities; they are reservoirs of genes that may be useful for the production of medicines and other commodities, for the maintenance of food supplies, or for ecosystem survival. South China is known for its richness in medicinal plants and besides, several plant species including some endangered plants recorded in the reserve have medicinal properties. The United Nations Environmental Program (UNEP, 1995), in its Global Biodiversity Assessment based on contributions by more than 1500 scientists stated that: it is clear that the loss of biodiversity has serious economic and social costs. The genes, species, ecosystems and human knowledge that are being lost represent a living library of options available for adapting to local and global change. Therefore, all life as well as the quality of life depends on plants.

Plants provide invaluable aesthetic and recreational benefits, they afford pleasure and relaxation to many people, and provide a source of inspiration in most art forms; they are the most visible elements of ecosystems. Longhushan reserve is all valleys and mountains, the area view from the summits gives a green peak cluster land form around a valley crossed by a green river (*Figure 1 and Figure 4*). The entire tourism activities in the reserve depend on the landscape view and its biodiversity. Tourism is also the most important activity in the locality and supports most of the local people jobs.

Rare species conservation is central to biodiversity conservation; Longhushan is located in Guangxi, one of the key tropical forest areas of southern China. Guangxi has more species of rare plants than any other province of China and Longhushan reserve, as a microcosm of Guangxi, reflects this rich diversity. In this study, from the plant species recorded, 12 were identified as endangered among which six are included in the IUCN red list for endangered species and three are endemic to China. The importance of these biological resources cannot be overestimated not only for China which is a leading center of biodiversity, but also for the global biodiversity conservation. As three of the endangered species are not found anywhere else but China and one of these three (*Camellia pubipetala*) is known only from Long'an (the study site county) and Daxin county, just next to Long'an. Moreover, with the presence of rare and endemic plant species, the fragility of the karst ecosystem, human and tourism impact including: primate damage, facilities, habitat fragmentation by small roads (*Figure 7, Figure 8*) there is a tendency of habitats destruction which leads to species extinction. Whereas these endangered species can only survive if their habitat is protected. Efficient conservation planning for the protection of rare plants is often overlooked as a result of lack of understanding of their ecological and biological importance. This is often the case where threatened tropical and subtropical species are concerned. As Raven, 1993 stated: Of all the global problems that confront us, this is the one that is moving the most rapidly and the one that will have the most serious consequences. And, unlike other global ecological problems, it is completely irreversible. Many question the importance of maintaining biodiversity in today's world, where conservation efforts prove costly and time consuming. The fact is that the preservation of all species is necessary for human survival and diversity of life and living systems are a necessary condition for human development

(Ishwaran et. al 2005). Species should be saved for aesthetic and moral justifications, the importance of wild species as providers of products and services essential to human welfare, the value of particular species as indicators of environmental health or as keystone species crucial to the functioning of ecosystems, and the scientific breakthroughs that have come from the study of wild organisms (Wilcove et. al 2008). In other words, species serve as a source of art and entertainment, provide products such as medicine for human well-being, indicate the welfare of the overall environment and ecosystem, and provide research that results in scientific discoveries. So, endangered species could prove to be useful to human development, maintenance of biodiversity and preservation of ecosystems.

Rare species are also indicators of endangered ecosystems; species are rare because the ecosystems they inhabit are unusual or degraded. In fact, in the reserve most of the rare plant species are endangered because of cutting and habitat clearance, overexploitation and lack of sufficient regeneration, logging and habitat loss. Rare species, therefore, are not isolated entities, but indicators of larger problems. Rare species help us determine which habitats require special conservation attention if a native biological diversity is to survive.

Rare species may perform valuable functions; with their habitats, they must also be conserved because more often than not, we do not know what critical functions they may perform, now or in the future. They may provide essential ecosystem services. They may be reservoirs of genetic diversity that will maintain sustainable food and commodity production. They may be required for other species or ecosystems to survive climate change or disturbances such as flood, fire or disease. A U.S. Forest Service fact sheet on biological diversity stated: the extinction of even a single plant species may result in the disappearance of up to 30 other species of plants and wildlife (USDA, 1993).

So Longhushan reserve, despite of its smallness could also be an interesting spot and open natural laboratory for researchers, students or other scientists to study botanical species including rare plant species, biological diversity, karst forest sustainable management, karst ecological system and the geomorphological interaction with vegetation formation.

Figure 7: Small roads through the forest

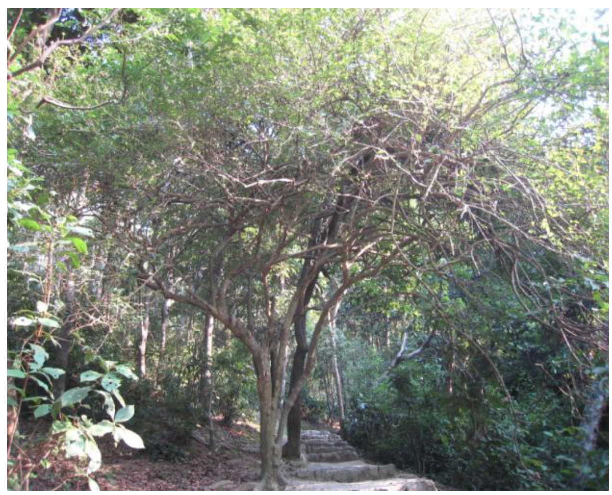

Figure 8: Primate Damage to the plants

5. Measures to avoid, minimize, and/or mitigate impact on rare plants survival:

Longhushan reserve, despite of its status as a natural reserve, might be not well known in term of wild and endangered species because there is very little record from previews studies. The field survey carried out for this research did not cover all the reserve, yet 12 endangered plants species were collected, which means there could be more. So before any measure can be taken, there is a need to implement a general survey of the reserve in order to record its faunal and floral species and identify all the species that are threatened or endangered of extinction. Then those species could be added to the Guangxi list of threatened and endangered species for its global monitoring and sustainable management strategies. Some of the main factors that cause species to become endangered in the area are habitat destruction and overexploitation. Habitat destruction is also known as the single greatest threat to species around the globe. Because destruction of habitat is now the principal cause of endangerment, habitat protection is the only effective way to save plants from extinction. The consequence of habitat protection is also a reduction in flooding with a corresponding reduction in soil erosion, ensuring survival of viable forests. It was noted in fact in the reserve that 2 quadrats X2 and X3 located on the banks of the Green River where vegetation has been cut to facilitate tourists' activities, were flooded every monsoon season. Soil, microorganisms and plants live together in a natural system with interdependence; conditions for improved functioning of this system must be facilitated and protected. In Longhushan this system is already fragile as shown by the results because of the karst geological and ecological background. So reducing human impact including deforestation, forest fragmentation, tourists' access to the forest or any other practices that can also influence the long-term buildup or depletions of soil OM, must be priority in order to maintain or improve habitats, geological and soil properties, vegetation cover. A crucial measure for the success of habitat conservation plan is the choice and implementation of measures to avoid, minimize, and mitigate impacts on the species. Therefore, the first step in Longhushan could be to conserve significant habitat areas within the reserve which means identifying which species are in danger of extinction throughout all or part of their range and adding them to the endangered species list. Species must be placed on the endangered species list if one or more factors put it at risk, including habitat destruction or degradation, overutilization. The reasons for rarity or scarcity must then be identified and controlled or eliminated. Key plant populations must be protected. This can require fencing, Invasive plant control, Planting native plants, ongoing research, propagation and reintroduction, biological monitoring/documentation, and educational meetings with the local people. A research and monitoring program for rare and threatened plant can also be elaborated upon, so once the extent of a plant species' distribution and population numbers are determined, a recovery plan can be developed to ensure the plant's survival. But protecting only one population is not a viable option as it could be destroyed by a catastrophe such as a cyclone or fire. Protecting several populations of a species is essential. Without genetic variation, a species becomes weak and more susceptible to other threats. Reforestation of deforested parts of the reserve for example the river side and former plantations is also necessary for soil erosion control. Other important factors can be also considered directly or indirectly as cause of plant species endangerment in the reserve: an important primate population with their damaging activities to the environment, important tourism activities, insufficient law enforcement of protected areas, and lack of monitoring and management plan for sustainability. In order to preserve habitat without endangering rare and vulnerable plant species, the following measures can also be undertaken:

- Ascertain and correct any inconsistency in the primate population data;
- Improve skills in primate censoring and monitoring by the reserve's staff;
- Understand the rate of high human impact through encroachment and tourism;
- Sufficient law enforcement of the protected areas;
- Monitoring and management for sustainability;
- Ascertain forest status for various habitat areas.

The plant species recorded in surveyed quadrats as endangered and endemic species require already special protection. More attention should be paid to maintaining their habitats at a high level of conservation as required; in order to keeping them from tourist access, habitat fragmentation by construction of roads for example or any other land use planning perspective, so as to protect those species. The primate population overloads vegetative community carrying capacity and tourism development also beyond the current environmental carrying capacity. So the primate population overloaded with the tourism development need to be addressed in relation to the vegetative community and the current environmental carrying capacity. Both problems should be under control in order to limit these impacts on the forest. Forbidding further felling and plantation activities in the reserve, the training of local people in the knowledge of keeping an ecological balance and further public awareness in order to encourage tourists to protect the existing forest is essential.

Note that Plant conservation is a long-term task especially in karst environment, with strategic significance. It is important for conservation of biodiversity and maintenance of a balanced ecosystem. In addition to the above measures, there still could be other research work to be carried out in the reserve. For instance, the ecology and reproductive biology of certain rare plant species could be further studied whereas advanced techniques on propagation of rare plants could be explored. These important tasks to succeed need the support of reserve managers, local academics and scientific researchers.

4 - Conclusion

Many research have been conducted in southern China concerning protected areas, karst ecosystem and biodiversity, but not much attention has been paid to small Nature Reserves like Longhushan. This study is significant not only because it contributes to the literature of the importance of plant protection including rare plant species in Longhushan karst environment, but also because it provides some evidence of karst ecosystem's fragility and the reserve's soil characteristics significance on the vegetation. Considering these characteristics per quadrat and the diversity of species, we could say that in Longhushan each karst environment is unique due to its localized conditions, geological and soil properties, former and current land use practices, climatic and micro-climatic conditions, hydrological and geomorphologic status. Soil erosion extremely faster than soil formation, soil moisture-short and mineral elements deficient or les available are the main factors impacting plants growth in karst area; so to avoid or minimize any practices that could trigger these factors must be a priority. Dolomite content appears to be the factor which played a part in the species distribution although other factors like elevation, aspect,... not analyzed in this study could also be significant environmental factors determining plant community and dominant species distribution. While the rare plants and dominant species responded differently to soil type, PH, moisture and OM content. All these characteristics of the karst environments create significant ecological niche differences across elevation gradients which need special attention for a better conservation of biodiversity, especially for endangered species for which habitat protection is fundamental for their survival. So, considering the sensitivity of the karst ecosystem and all the geological and soil properties, the vegetation formation or restoration once destroyed must be a slow and difficult process; because karst areas have a typical thin soil and vegetation deficient in nutritive elements, very sensitive to anthropogenic disturbance**s.** The vegetation cover is considerable in the reserve which makes it even more special and deserves close attention for their protection knowing that many plant species are endangered in the reserve and several southern China karst areas are now threatened by rock desertification.

Therefore, rare plant species must be conserved so that Longhushan ecosystems can continue to provide the ecosystem services that drive the Guangxi economy and enhance the quality of life. We all depend upon plants and wildlife. From studying them, we have learned new ways of growing foods, making clothing, and building houses. If we fail to protect threatened or endangered species, we will never know how they might have improved our lives. The potential for economic and material benefit is unlimited and we have barely begun to exploit the wealth of useful products contained in wild plants. At this early stage, we cannot afford to let plants become extinct - once lost, a species can never be recreated. Plants are a part of our natural heritage - a heritage that we have an obligation to preserve for the benefit of future generations of mankind.

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Correspondence to:

Dado Toure
China University of Geosciences (Wuhan)
School of Environmental Studies
Lumo Lu, Wuhan, Hubei 430074, China
Cell phone: 0086-27-62521159; 0086-15972993853
Email: touredado@yahoo.fr

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