



木论喀斯特 林区概论

◆ 郑颖吾 主编

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木论喀斯特林区概论

Introduction to Mulun Karst Forest Region

主 编 郑 颖 吾

副主编 孙 惠 南

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内 容 简 介

本书系中亚热带广西环江县木论喀斯特林区的考察研究成果。全书在概述木论喀斯特林区基本情况的基础上,分别论述了该区地质与水文、地貌与洞穴、林下土壤、植物区系、森林植被、森林资源、大型真菌、动物资源、昆虫资源和生物喀斯特等主要内容。书中还附有彩色图版12面、生物名录等。全书重点侧重生物部分,对认识、保护和开发该林区具有重要意义,填补了该林区综合研究的空白。可供生物、地理、环境、森林等专业人员、有关决策管理部门和当地政府有关人员阅读参考。

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前 言

木论喀斯特林区位于广西环江毛南族自治县西北部,北与贵州省茂兰自然保护区(国家级)相连。在中亚热带南缘还保存着这么一大片喀斯特森林,是人类的宝贵财富。然而,这里位置偏僻,交通不便,人迹罕至,一直不为人们所注视。对该林区森林生态系统的属性和特点,资源的种类和性状,以及科学意义和经济价值如何认识,今后应采取什么措施等一系列问题,至今尚未被人们确切知晓。为了回答这些问题,提出了广西环江县木论喀斯特林区综合考察项目。该项目由广西壮族自治区林业厅主管,得到广西壮族自治区科学技术委员会、广西壮族自治区计划委员会国土办公室的支持,由广西科学院和环江毛南族自治县人民政府承担,具体由环江县政府组织实施,分别于1993年和1994年进行了多学科综合考察。第一年于1993年8月19日至9月3日,历时16天的外业初查,获得了大量第一手资料,并于当年11月写出专题报告和总结,同时,编制了像册和录像等较详细的初步成果,于同年12月5日在自治区科委会议厅举行汇报会,向自治区有关领导、专家和新闻单位汇报,得到好评,一致认为该项考察很重要,需做进一步详查。次年,于1994年8月4日至9月2日,又进行了历时30天的外业调查,其中动物组单独进行了一个多月的蹲点采集调查。

该考察首要任务是摸清该林区被保护对象的家底,故组织以生物为主的综合考察队。参加者有:广西植物研究所、广西科学院生物研究所、广西壮族自治区林业厅、广西壮族自治区林业勘察设计院、原地质矿产部岩溶地质研究所、广西地质学校、山西农业大学、广西农业科学院植物保护研究所、广西河池地区林业局和广西环江毛南族自治县林业局等10个单位的专业人员共28人。计有植物区系、植被、林业、大型真菌、动物、昆虫、生物喀斯特、地质与矿产、地貌与洞穴、土壤、水文地质和旅游等12个学科。在300km²范围内,采用线路踏查与样方调查、察看与访问相结合的方法,并充分利用摄影与录像手段。选择乐衣、社村为据点,林区内设中伦、红峒、外峒为临时据点。1993年路线为木论—乐衣—苦峒—外峒—长峒—外峒—中伦—木论—社村—黎门关—社村;1994年路线为木论—中伦—红峒—外峒—社村—大沙坡—社村。考察方式,是定点并向四周辐射深入林区各部位进行调查。

两年累计46天的外业调查,行程共450km(水平距离),在坡陡路滑、穿越艰难的条件下,做各类植被样地84个,总面积9326m²;挖土壤剖面22个;探洞10多个;采集各类标本5500号(外加1991年广西植物研究所滇黔桂植物区系调查在该林区采集的500号植物标本);分析样品85件;在调查中对生长在不同地段的部分树种进行了年轮观测,个别做了树干解析。经过约半年时间的标本鉴定,样品分析,内业整理,撰写出9篇

专题考察报告和综合报告,以及编制像册和录像片。基本上摸清了该林区的自然资源,侧重生物资源的家底,其中属于国家保护和珍稀濒危动植物 52 种,并发现了 29 个新种,25 个中国、广西分布新纪录种和 2 个广西新纪录属,为争取设站保护提供了科学依据。

本考察队是因工作需要组建的临时性组织,工作方式是:集中野外调查,分散回单位挤时间完成各自的内业,由队长一人到桂林、南宁协调统一全队工作。经大家艰苦努力,终于圆满完成任务。专题报告经郑颖吾、金代钧两人审阅,提出意见返还执笔人修改定稿,文责自负。主要参考文献、相关照片附在报告后面。原始资料各自保存,本队有权调用。为使所获资料不散失,维护专家利益,先作内部处理。为了报请上级有关部门和有关专家评审,曾将所有考察资料汇集成册,提供了一个较完整的雏形。但由于该区原有工作基础薄弱,除地质水文、植物区系和森林资源等有点资料外,其余几乎全是空白(地下块菌、生物喀斯特两分支专题也是以往考察所没有的,为本次考察新增项目)。同时因时间短促,仅有一个多月时间进行审定收编工作(同时还要编制录像),自知粗糙,但却实事求是。

纵观而论,“木论”确是块罕见稀有宝地,在严酷的喀斯特生境下,仍残存着一大片森林,其生物多样性相当丰富,令人惊喜。若不加以保护,任其破坏,不仅毁了这么一大片森林,而且对其相邻的茂兰自然保护区(国家级)也是一种威胁,故抓紧调查,摸清家底,上报有关部门,成立国家级自然保护区,使该区确实得以保护,是当务之急。在我两年的任期(科技副县长)中,就做这件事已相当困难,还是先调查后立项,好在得到当地各级政府部门的支持和有关科研院校的协作,才匆匆完成这次调查任务,当初并未打算正式出版。后于 1995 年北京香山成果鉴定会上,与会专家和领导认为,这些资料取之不易,非常可贵,建议出版。

如今展现在读者面前的,就是上述两年考察的总结和研究成果。它是在原初编报告的基础上,作了大量充实、增删、提高、完善工作,编纂而成。本书的出版得到广西壮族自治区林业厅的经费资助,林业厅副厅长钟国华自始至终对我们的工作给予支持和帮助;区科委张正铀主任十分支持和关心我们的科考工作;林业设计院高级工程师钟业聪在组队时出了不少好主意;环江县领导谭会云、谭三川县长,覃继贤副县长,环江县委黄克书记,作为东道主更是主动积极参与和支持,不光在野外工作时,而且在各种条件保障上,均给予支持;科学出版社领导对本书的出版惠予大力支持和照顾,吴三保编审对出版给予热情支持和帮助,在此一并表示衷心地感谢。

本书各章的执笔人如下:第一章郑颖吾;第二章傅中平;第三章王福星、曹建中;第四章梁其彪,李瑞英参加样品分析;第五章第一、二、三、七节韦发南,第四节文和群,第五节韦毅刚,第六节刘演;第六章第一、二、三节赵天林,第四、五节宁世江;第七章李世裕、许志宏,树干解析陈伦祥,资料统计覃文更、宋群儒;第八章常明昌;第九章周放;第十章蒋国芳;第十一章王福星、曹建中;录像解说词郑颖吾。各章审稿人如下:第一章孙惠南;第二、三章宋林华、林钧枢;第四章黄荣金;第五、六章王献溥;第九、十章张荣祖。以下资料由下列同志提供:旅游,蒙林坚、傅中平;社会经济,覃文更;英文翻译孙惠南,杨周怀校。本书插图清绘叶池;照片除个别由环江县旅游局供稿外,全系考察队供稿。本书系集体劳动成果,绝大部分资料来源于考察报告,故将科考队名单、录像作为附件编入(见书末附件)。

限于经费、时间和我们的水平，书中难免有不当甚至错误的地方，诚恳希望得到专家和读者的批评指正。

借此机会，对理解和支持本项考察研究与编辑出版工作，并给予帮助的其他单位和个人，在此亦表示衷心地感谢！

郑颖吾

1998年3月于北京

General Situation of the Mulun Karst Forest Region

1 The Natural Condition

(1) *Geographical position*

Mulun karst forest region is located in the northwest of Maonan Autonomous County of Guangxi. The forest region occupies the area of about 15800hm². The planned natural protection is located in the southern edge of the region. The geographical coordinate are E107°54'01"—108°05'51" and N25°07'01"—25°12'22". The distance from east to west is 19.80km, from south to north is 10.75km. The total area is 8969hm². There is a Protection Point in the mountain area of Bannancun with the forest of *Kmeria septentrionalis*.

(2) *Geology and geomorphology*

Mulun karst forest region is on the mountain Miaoling and surrounded by the karst area. In the tectonic it belongs to the South China Peneplatform and there are some faults with northeast and northwest direction.

The stratum of this area is comparatively simple. There are mainly the carbonate layers cropped and 5 calcareous layers were distributed mainly consisted of limestone and dolomite, then the Quaternary loosely accumulations. The dip angle is 10°—15°, the total thickness of the layer is 1103m. The karst forest were protected very well.

In the region, the karst geomorphologic landform is developed widely. The karst morphology with different forms of conic mountain and pagoda mountain are very beautiful and interesting. Between the mountains there are depressions and plains along with the faults. The mountains are always precipitous and the depressions always have underground rivers and caves with stalagmites and stalactites.

(3) *Climatology and hydrology*

The Mulun karst forest region is in the north side of the north tropic and belongs to the subtropical monsoon climate region. The solar radiation and water resources data of this region are listed in Table 1-1. The solar radiation and sunshine intensity are reduced by the mountain forest. The annual global radiation is 3832 MJ/m² (latitude N 25°9', altitude 600m). The minimum of the daily global radiation is 6.6 MJ/(m² · d) in

January. The total monthly global radiation is 204.6 MJ/m^2 , 5.3% of the annual global radiation. The minimum of the daily global radiation is $14.5 \text{ MJ/ (m}^2 \cdot \text{d)}$ in August. The total monthly global radiation is 449.5 MJ/m^2 , 11.7% of the annual global radiation.

The ratio of the mean total daily radiation from winter to summer is 0.51. The mean annual daily global radiation is $10.50 \text{ MJ/ (m}^2 \cdot \text{d)}$.

The difference of the latitude from south to north is $5'21''$, and the difference of the relative altitude is about 500m. The micro-climate of the forest area has changes along with these difference. The average annual temperature in the forest region is $15 - 18.7^\circ\text{C}$. The average month temperature of January is $3.4 - 8.7^\circ\text{C}$, and the average month temperature of July is $23 - 26.7^\circ\text{C}$. Annual temperature difference is 18.1°C . The accumulation temperature of $\geq 10^\circ\text{C}$ is $4700 - 6300^\circ\text{C}$. The frost free period is 235 - 290 days. The annual precipitation is 1530 - 1820mm. If we take the 600m as the standard altitude, the annual precipitation is 1638mm, in rain season (April - August): 1207.1mm, 73.7% of the annual precipitation. In dry season (September - March): 430.7mm, 26.3% of the annual precipitation. In flood season (June and July): 635.3mm, 38.8% of the annual precipitation. In most dry months, December and January, the precipitation is less than 30mm.

The annual potential evapo-transpiration is 874mm. The monthly evapo-transpiration in July and August is more than 100mm and in December, January and February is less than 50mm.

The surface water is not developed well. The water in the forest mainly is from the crevasse of carbonate rock. The ground water is mainly supplied from the atmosphere precipitation, 70% of which is in the period of April to August. In the period of dry season the precipitation is not enough to supply the ground water, so some of the under ground river and spring become dry. The depth of the buried ground water depends on the topography. It is more deep in northwest and middle part of the region and shallow in southeast. In the forest the surface can intercept the water and the well developed roots of the vegetation can reach rather deep water table and absorb the water. This is a special hydrologic character of the karst forest.

The water chemistry in the region, mainly is the calcium carbonate type and calcium-magnesium carbonate type. All are the freshwater of low mineral content ($100 - 300\text{mg/L}$). Most of them are soft water. The pH value is 6.4 - 8.

Because of the good geographical location, the cold air mass from northwest and typhoon from southeast are blocked by the mountains around the region. The climate in forest is moderate and cool and often with fog. There are no hot summer and cold winter. The precipitation is abundant, but the penetration is severe. Usually in the dry season the shortage of water is severe.

(4) Soil conditions

The bare rock reach about 80%—90%, and the mantle rock is less than 20% only distributed on the cracks of the rock. Only on the depression and valley there is soil cover with larger area. It formed by calcareous soil from the weathering of the limestone. The soil cover is thin. The soil layer is not clear and not developed well. In the forest region there is abundant defoliation and obvious biological accumulation. The organic content is rather high, usually reaches 5.0%—7.5%. The layer of the deadwood and defoliation reaches 3—6cm. Because of the wet in the forest the soil moisture is also high. The eluviation is strong and the pH value is between 6.5 to 7.0. The soil texture is rather heavy. Most of them is heavy loam or light clay.

2 Biological Resources

Warm and humid climate, various karst geomorphology and island form environment are good to the multiply of the plants and animals. The karst forest region is the center of series biological fauna and flora. Here the biological flora and fauna are complicated. The species are very abundant. It is a very important gene pool of the species resources.

(1) Plant resources

Mulun karst forest region, as a natural protection region has the area of 8969hm². The forest coverage is 94.7%. Together with the area of shrub-forest of 61.1hm², the coverage will reach 95.4%. The total standing timber value is 590,820m³, in average is 69.5m³ per hm². All these data rank the first in Guangxi. The forests can be divided into 3 parts: east part, middle part and west part. The middle part is better than the east and west parts, the trees are higher, and the tree quality also is better than the east and west parts. Generally the tree quality is better in middle part of the slope than on the top and slope foot. In the slope foot, there are mainly secondary forest and partly became shrub or brushwood.

There are 908 species of vascular bundle plants, belonging to 159 families and 527 genera, among them 67 species are fern, 11 species are gymnosperm and 830 species are angiosperm. In the *Plant on the limestone in China* there are 197 families, 1213 genera, 4287 species distributed naturally on the karst rocks of Guangxi, Guizhou and Yunnan. Among them, there are 154 families, 466 genera and 541 species in Mulun, occupied 78.1%, 38.4%, 12.6% of the total in China and 96.8%, 88.4%, 59.6% of the total in Mulun 5 new families were increased for China from Mulun. There are 22 special species in Chinese limestone region and Mulun, i. e. *Handeliidendron*, *Pteroceltids*, *Heteroplexis*, *Platycarya* and *Sanicula*, 5 genera, occupying 22.7%. There are 3 endemic genera in the limestone region. In Mulun there is one genus, *Nandina*,

occupying 33.3%. There are 11 endemic genera in the semi-limestone. Mulun has 4, i. e. *Pistacia*, *Paraboea*, *Hemiboea* and *Chirita*, occupying 36.4%.

The ratio of the species to genera is 1.72. It is obviously lower than the ratio on the whole country (8.5), Guangxi (4.1) and southern region and southwest of the limestone region (3.5). There are single species genus and less species genus. For instance *Houttuynia*, *Pteroceltis*, *Nandina*, *Toddaalia*, *Choerospondias*, *Eurycorymbus*, *Handeliendendron*, *Camptotheca*, *Kalopanax*, *Phryma*, and *Zenia* etc. 11 are single genus, the *Calocedrus*, *Kmeria*, *Tirpitzia*, *Itoa*... *Amentotaxus*... *Pegia*, *Sinosideroxylon* etc. altogether 30 genera with 34 species are the genera with less species (2—4 species). Most of them are endemic species of the limestone region. Some of them are the endemic species of our country. Some are the edificato of the Mulun forest region. Typical arbor species of the limestone are *Keteleeria calcarea*, *Pseudotsuga brevifolia*, *Acersycopseoides*, *Cheros-pondias axillaris*, *Pistacia chinensis*, *Cyclobalanopsis* sp., *Miliusa chunii*, *Carpinus pubescens*, *Carpinus rupestris*, *Radermachera sinica*, *Viburnum propinquum*, *Diospyros dumetorum*, *Sapium rotundifolium*, *Lindera communis*, *Cladrastis platycarpa*, *Toona sinensis*, *Rapanaea kwangsiensis* and *Celtis biondii* etc.; shrub: *Sarcococca ruscifolia*, *Pittosporum ovoideum*, *Polygala wattersii*, *Murraya paniculata*, *Turpinia montana* and *Daphne papyracea* etc. The herbage are *Pteris vittata*, *Anemone begoniifolia*, *Brandisia hancei* and *Iris japonica* etc. This shows that Mulun Natural Protect Area is a typical karst virgin forest. It has a very important significance for the study of the history and present situation of the flora.

Among the 908 species of the vascular plants there are 27 precious and endangered species, among which 5 are the protective species under the second grade of the national level, 10 are the protective species under the third grade of the national level. There are 12 new species, 2 new record genera of Guangxi and 12 new record species of Guangxi had been published or confirmed. The new species are: *Pinus calcarea* F. N. Wei, *Beilschmiedia ovoidea* F. N. Wei, *Cryptocarya microcarpa* F. N. Wei, *Clematis revoluta* F. N. Wei, *Berberis uniflora* F. N. Wei et Y. G. Wei, *Dicentra guangxiensis* Y. G. Wei et F. N. Wei, *Leptopus huanjiangensis* F. N. Wei, *Pithecellobium multifolilata* H. Q. Wen, *Distylium ferruginea* Y. G. Wei et F. N. Wei, *Vaccinium huanjiangensis* F. N. Wei, *Hemiboea magnibracteata*, Y. G. Wei et H. Q. Wen and *Ilex pseudokudingcha* H. Q. Wen. 2 new record genera of Guangxi are *Dicentra* and *Ampelocalamus*, 12 new record species of Guangxi are *Cinnamomum caudiferum*, *Cephalotaxus fortunei*, *Michelia angustiolonga*, *Distylium cuspidatum*, *Acer laevigatum*, *Acerpaxii*, *Rhododendron ambiguum*, *Vaccinium pseudotonkinense*, *Symplocos urceolaris*, *Lonicera* sp., *Ampelocalamus calcareus* and *Phaius guizhouensis*.

Among the 908 species of the vascular plants there are also abundant resource plant 800 species can be exploited. According to the economic usage, there are: 390 species of the medical plant, 103 species timber plant, 30 species aromatic plant, 70 species

nectariferous of the plant, 104 species of oil plant, 20 species of amylophyllous plant and 342 species of afforestation and ornamental plant.

In the upper layers of natural forest vegetation mainly are the *Machilus pauhoi*, *Machilus kwangtungensis*, *Lindera communis*, *Beilschmiedia kweichowensis*, *Cinnamomum parthenoxylon* of the LAURACEAE; *Bridelia fordii* (deciduous) of the EUPHORBIACEAE; *Pteroceltis tatarinowii* (deciduous), *Celtis tetrandra* (deciduous), *Zelkova serrata* (deciduous) of the ULMACEAE; *Kmeria septentrionalis* of the MAGNOLIACEAE; *Quercus glauca*, *Quercus phillyraeoides*, *Quercus engleriana* of the FAGACEAE; *Boniiodendron minius* (deciduous), *Eurycorymbus cavaleriei* (deciduous), *Handeliiodendron bodinieri* (deciduous) of the SAPINDACEAE; *Platycarya longipes* (deciduous) of the JUGLANDACEAE; *Carpinus pubescens* (deciduous) of the BETULACEAE; *Itoa orientalis* (deciduous) of the FLACOURTIACEAE; *Swida parviflora* (deciduous) of the CORNACEAE; *Pinus kwangtungensis*, *Pinus calcarea*, *Pseudotsuga brevifolia* of the PINACEAE; *Calocedrus macrolepis* of the CUPRESSACEAE; *Acer laevigatum* of the ACERACEAE; *Pistacia chinensis* (deciduous), *Allospodias lakonensis* (deciduous), *Choerospondias axillaris* (deciduous) of the ANACARDIACEAE; *Diospyros oleifera* (deciduous) of the EBENACEAE; *Elaeocarpus japonicus* of the ELAEOCARPACEAE; *Radermachera sinica* (deciduous) of the BIGNONIACEAE; *Vitex quinata* of the VERBENACEAE; *Styrax suberifolia* (deciduous) of the STYRACACEAE; and *Cladrastis platycarpa* (deciduous) of the PAPILIONACEAE. In the middle and low layers there are mainly *Cleidion bracteosum*, *Schefflera octophylla*, *Mallotus philippinensis*, *Sapium rotundifolium* (deciduous), *Neolitsea confertifolia*, *Rapanea kwangtungensis*, *Viburnum triplinerve*, *Diospyros dumetorum* (semi-evergreen), *Leropetalum chinense* (deciduous), *Ficus glaberrima*, *Ficus gibbosa*, *Celtis biondii* (deciduous), *Sinodendroxylon pedunculata*, *Sterculia euosma* and *Phoebe calcarea* etc. Most of them are limestone plants or endemic species, being the main element of the edificato and dominant species. The plant community is complex with diversified ecological types. For instance in the sample square of 600 m², there are 30—36 families, 60—70 genera and 65—76 species. Among the 172 species of the arbor, there are 109 species of the evergreen trees, occupied 63.4%, 63 species of the deciduous trees, occupied 36.6%. Evergreen tree predominates the shrubby and layer under the forest. The proportion of the deciduous trees depends on the position of the slope, proportion of the bare rocks, soil fertility and dryness. In the total, mainly there are the evergreen trees and the proportion of the deciduous tree is also not too low. The ratio of the evergreen to the deciduous tree are about 6 : 4. The forest belongs to the middle subtropical mixed forest of the evergreen and deciduous broad leaf trees in limestone region. It distributes from the valley to the slope and the top. Only on the ridges and the top of the mountains higher than 800m, there is the mixed forest of evergreen and deciduous broad leaf trees with conifer. On the top of the mountains

with worse habitat, there formed the mountain-top coppice. On the better habitat, there are thicker *Calocedrus macrolepis* and *Pinus kwangtungensis*. On the slope foot, there are secondary forests, partly become to cluster and brushwood because of the interference of the human activities.

Evergreen and deciduous broad leaf forest on the limestone, mainly has the type of simple leaf, leathery leaf with middle size. The bark is always smooth with light color. The canopy of the forest has a light color. In spring and summer it is dark green with some light green spot. In autumn it always with a mixed color of red and yellow. Only in winter, the color is gray and brown. The stratification here is obvious. There are always three layers of arbor, shrub and herbage, and the arbor can be divided into 3 layers. Because of the limestone mountainous condition the tree grows slowly and the diameter is small. Usually the annual diameter grows only 0.2—0.3cm. The maximum is 0.52cm and minimum —0.08cm. Generally speaking, the region has large area of the continuous forest with high coverage and good conservation. The composition of the tree species is very complex. The structure is rather diversified. The outlook is beautiful. The forest resource is not for timber, but for protection and management. Because of the asperity of the environment, once the forest was destroyed, it will not existed any more, and become a rock desert. There are many such serious lessons.

In the thick forest the tree leaves hindered the sun shine, and the air is always wet. This reduced the air temperature. All these provide a condition to grow the moss and alga around the lower part of the trunk and rock surface. In the sparse forest, or edge of the forest and the land without forest the condition is comparatively dry, there is mainly the lichen in shell shape. There are 3 families and 3 genera of bryophyte, 6 families and 6 genera of moss. 3 orders, 9 families and 30 genera of blue algae and 2 orders, 2 families and 3 genera of green algae and 6 orders 8 families 8 genera of lichenes had been identified. As a part of the composition of forest plants, moss and algae pay the role of water source conservation and protect the soil. They pay a precursor role in the reconstruction of the forest ecology.

There are fungus of different types in the forest region. Their nutrient stripping are different from the photosynthesis of plant, and also to different from the absorption the nutrient of animals. Their nutrient stripping belongs to the type of decomposition-absorption. They pay an important role in the material cycle, energy conversion and ecosystem balance. There are 68 species (20 orders, 30 families, 46 genera) of the large fungus had been identified, among them some can be used for edible or for medicine. More than 10 species of underground truffle have been found, they have abundant nutrient with nice test. They have a very good salability in the international market.

(2) wild animal resources

In the very well preserved large area of forest, there are also abundant animal

resources. There are 260 species (70 families) of terrestrial vertebrate had been identified in Mulun karst forest region. Among them 17 species are amphibian, occupied 6.5% of the total, 47 species are reptile, occupied 18.1%; 148 species are birds, 56.9%; 48 species are mammalian, 18.5%. 2 species of them are belong to Grade I of national protective animal, and 27 species Grade II of national protective animal (see Table 1-3).

On sub-species of birds (*Napothera brevicaudata huanjiangensis* Zhou) had been found, identified and named.

(3) The Tourist resources

Mulun karst virgin forest is peculiar for the region of such a latitude. It has a special ecological environment and diversity landscapes. There are plenty types of landscapes, like depression forest, funnel forest, valley forest and basin forest. There are various precious species, endangered species and rare plants and animals, also some endemic species. People call the region a natural botanical garden. This is a valuable scenic spot for science and tourism.

There are plenty tourism spot, which can drive the tourism of this region, such as the aven with waterfall of 60 — 70 m with an area of a football field in village Hongdongcun. This hole is surrounded by forest and is very pageantry.

Gourd stone pagoda was built in the time of Yongzheng of Qing Dynasty. It is rampart by laying stones. The top of it has a shape of gourd. Now it is located in yard of Duchuang primary school.

The Great Star pagoda has been built in Daoguang 21 year of Qing Dynasty (1841). It is based on a big bluestone and was rampart by laying bricks with 7 floors of hexagon shape. There are stairs reach the top of it. The inside diameter of the first floor is 2 m. The Great Star pagoda stands by the riverside and has a beautiful inverted reflection in water.

Gravestones in Fengtengshan is a cemetery of the Maonan nationality. There are more than 700 tumulus with steel and lettering. All of them are built by laying marble with carved dragon, phoenix and butterfly. The lettering and pattern are very precious. This is one of the art treasury of Maonan nationality.

Above mentioned tourist spots are around the Mulun karst forest region.

(4) Assessment and suggestions

1) Mulun karst forest region belongs to the mixed forest ecosystem of evergreen and deciduous broad leaf. It is an apex community of the forest vegetation on the intrazonal limestone area, and is a typical karst forest ecological environment.

2) Mulun karst forest region is very rare in compare with same latitude on the world. It characterize its large area of natural vegetation (Total area of the region is

89.690km² with forest area 84.997km²), continuous well preserved forest and high forest coverage (94.8%). All these all occupies the first position.

3) Biological resource in the region is abundant, and there are plenty precious species and endangered species of plants and animals. Some of them are endemic species in this region. 21 species of plants and 29 new species of animals have been identified under the keystone national protection. 12 new species of plants, 1 sub-species of animals and 16 species of insects have been found and named. There are various valuable underground truffle.

4) The region can support the experimental base for biology, ecology and biogeography. It can pay the role of the water source protection, regulate the local climate, prettify the environment and tourism.

5) Enhance the propaganda to protect this valuable region and to avoid any human interfere.

6) Declare the national protection region to relevant ministries.

7) Integrate planning for the natural resource and natural environment.

8) Introduce the most valuable and rare plants, in endangered condition for their protection. Development some species such as the valuable underground truffle and medicine plants to the market.

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