

## World Heritage Sites

### Protected Areas and World Heritage



## SOUTH CHINA KARST CHINA

*These three remarkable landscapes are spectacular representatives of forested humid tropical to subtropical karst. They show an exceptional variety of karstic forms and the evidence of their complex evolution, some being world reference types for these landforms. Visually, especially in the Shilin stone forests, the effects are astonishing for their fantastic and bizarre picturesqueness.*

### COUNTRY

China

### NAME

South China Karst

### NATURAL WORLD HERITAGE SERIAL SITE

2007: Inscribed on the World Heritage List under Natural Criteria vii and viii.

### STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee issued the following statement at the time of inscription.

South China is unrivalled for the diversity of its karst features and landscapes. The property includes specifically selected areas that are of outstanding universal value to protect and present the best examples of these karst features and landscapes. South China Karst is a coherent serial property comprising three clusters, Libo Karst and Shilin Karst, each with two components, and Wulong Karst with three components.

**Criterion (vii):** South China Karst represents one of the world's most spectacular examples of humid tropical to subtropical karst landscapes. The stone forests of Shilin are considered superlative natural phenomena and the world reference site for this type of feature. The cluster includes the Naigu stone forest occurring on dolomitic limestone and the Suyishan stone forest arising from a lake. Shilin contains a wider range of pinnacle shapes than other karst landscapes with pinnacles, and a higher diversity of shapes and colours that change with different weather and light conditions. The cone and tower karsts of Libo, also considered the world reference site for these types of karsts, form a distinctive and beautiful landscape. Wulong includes giant collapse depressions, called Tiankeng, and exceptionally high natural bridges between which are long stretches of very deep unroofed caves. These spectacular karst features are of world class quality.

**Criterion (viii):** Both Shilin and Libo are global reference areas for the karst features and landscapes that they exhibit. Major developments in the stone forests of Shilin occurred over some 270 million years during four major geological time periods from the Permian to present, illustrating the episodic nature of the evolution of these karst features. Libo contains carbonate outcrops of different ages that erosive processes shaped over millions of years into impressive Fengcong (cone) and Fenglin (tower) karsts. It contains a combination of numerous tall karst peaks, deep dolines, sinking streams and long river caves. Wulong represents high inland karst plateaus that have experienced considerable uplift, and its giant dolines and bridges are representative of South China's Tiankeng landscapes. Wulong's landscapes contain evidence for the history of one of the world's great river systems, the Yangtze and its tributaries.

The property is well managed, with clear management plans in place and the effective involvement of various stakeholders. There are strong international networks in place to support continued research and management. Of the three clusters, Wulong has suffered the least human impact by virtue of its remoteness and retains natural values that have been reduced in other comparable areas. Continued efforts are required to expand and refine buffer zones to protect upstream catchments and their downstream and underground continuation in order to maintain water quality at a level that ensures the long term conservation of the property and its subterranean processes and ecosystems. At Wulong the boundaries of the core zone should be considered for extension, and a

single landscape-scale buffer zone would be a significant improvement to encompass all of the Tiankeng elements to the north of the Furong gorge. Traditional management by minority peoples is an important feature of both clusters, and the relationship between karst and the cultural identity and traditions of minority groups including the Yi (Shilin) and the Shui, Yao and Buyi (Libo) requires continued recognition and respect in site management. Potential for further extension of the property requires development of a management framework for effective coordination between the different clusters.

## **INTERNATIONAL DESIGNATION**

1996: Maolan National Nature Reserve designated a Biosphere Reserve under UNESCO's Man and Biosphere Programme (21,330 ha).

## **IUCN MANAGEMENT CATEGORY**

Shilin National Park:	Unassigned
Maolan National Nature Reserve:	V Protected Landscape
Zhangjiang National Scenic and Historic Area:	Unassigned
Furongjiang National Scenic and Historic Area:	Unassigned

## **BIOGEOGRAPHICAL PROVINCE**

Shilin: Chinese Subtropical Forest (2.1.2);

Libo: Oriental Deciduous Forest (2.15.6);

Wulong: Sichuan Highlands (2.39.12).

## **GEOGRAPHICAL LOCATION**

These three similar karstic regions are located in southwest China. Shilin Karst is 78 km northeast of the city of Kunming in Yunnan Province, centred on 24°47'30"N by 103°16'30"E; Libo Karst is some 150 km southeast of Guiyang city in Guizhou province, centred on 25°13'15"N by 107°58'30"E; and Wulong Karst is some 110 km east of Chongqing city, Sichuan province, centred on 29°13'48"N by 107°54'12"E. Libo is equidistant 435 km from both Shilin and Wulong which are some 600 km apart.

## **DATES AND HISTORY OF ESTABLISHMENT**

- 1931: Shilin Stone Forest designated a Yunnan Provincial Park; 1942: first development plan, later revised 3 times;
- 1982: Shilin designated a National Scenic & Historic Area and National Park;
- 1987: Twenty-year (1982-2002) masterplan approved; updated 2004;
- 2001: Shilin stone forests designated a National Geological Park;
- 2004: Shilin designated a UNESCO Global Geopark.
- 1975-85: The Libo area karst forest was discovered and surveyed;
- 1988: Maolan National Nature Reserve designated (part of Libo east site);
- 1994: Zhangjiang River designated a National Scenic & Historic Area (part of Libo west site);
- 1996: Maolan Reserve designated a UNESCO Biosphere Reserve;
- 1992: Furong Dong (cave) discovered; 1995: protective measures adopted for Furong Jiang (river);
- 1998-2002: Three Natural Bridges (Sanqiao) and Houping karst investigated for karst and tourist resources;
- 2002: Furongjiang area declared a National Scenic and Historic Area;
- 2003: Wulong Karst declared a National Geological Park;
- 2005: Wulong Karst management plan adopted.

## **LAND TENURE**

Shilin Karst: State, rural collective and private, in the Yi Nationality Autonomous County of Shilin.  
Libo Karst: State and private, in the Southern Guizhou Buyi and Miao Nationalities Autonomous Prefecture, Guizhou. Wulong: State and private. Wulong Karst is in Wulong County, Chongqing City, Sichuan.

## AREAS

Total core area: 47,588 ha  
Total buffer zone: 98,428 ha  
Total of core and buffer zones: 146,016 ha

Site	Total area	Core area	Buffer zone
Shilin:	35,000 ha	12,070 ha	22,930 ha
Naigu Stone Forest Suogeyi Village		1,746 ha 10,324 ha	
Libo:	73,016 ha	29,518 ha	43,498 ha
Xiaoqijiong Dongduo		7,834 ha 21,684 ha	
Wulong:	38,000 ha	6,000 ha	32,000 ha
Qingkou Tiankeng Sanqiao Furongdong		1,246 ha 2,202 ha 2,552 ha	

Libo's east site incorporates Maolan National Nature Reserve.

Libo's west site includes parts of the Zhangjiang Scenic and Historic Interest Area.

Wulong incorporates Furongjiang Scenic & Historic Interest Area and National Geological Park.

## ALTITUDE

Shilin: 1,560m - 2,203m (Mt.Wenbi);

Libo: -385m - 1,109m

Wulong: -200m - 1,510m

## PHYSICAL FEATURES

The nominated sites are spread across nearly 500,000 square kilometres of subtropical karst landscapes in southern and southwestern China (7.15% of the country's area). This is mostly based on a very thick sequence of hard compacted limestones and dolomite laid down during early Permian to Triassic periods 270 million years ago. The limestone platforms are situated at the junction of the Indian, the South China and the Pacific plates and are subject to tectonic movement. The four main movements which uplifted them occurred during a continuous cycle of uplift and denudation, deposition and erosion in the Palaeozoic period 400-250 million years ago (mya), in the late Triassic, 200 mya, in the Jurassic to Cretaceous periods, 200-70 mya and in the Eocene Himalayan orogeny 50 mya. Originally continental marine limestones were overlaid in the Permian by basalt and in the Cretaceous and Tertiary periods by marine sand and clay deposits. In the west the area was uplifted some 1,200m to become a plateau during the Himalayan orogeny, accompanied by jointing; in the east it has been stable or slightly subsiding. It is unglaciated and the climate and erosive forces have always been tropical and humid, promoting dissolution. The result of this complex of processes is an enormous range of karstic landscapes: knife-edge pinnacles, deep sharp fins (karren), towers, pillars, cones, gorges and caves, all still subject to erosion. The process also left an eloquent record in fossils from late Palaeozoic times on.

In Shilin the two sites, the Lunan and Naigu stone forests, lie along 20km of an undulating plateau, divided by 4.5km of a populous valley. They are excellent examples of plateau karst pinnacles and knife-edged karren, representative of the many stone forests of the South China Karst, formed mainly in late Permian carbonates from the complex fracturing and lattice jointing of the uplifted plateau. Stone forests resulted from frequent fissuring, hills from infrequent fissuring, and razor ridges where the two fracture planes intersected. Their formation was complex: stone forests and teeth formed from the Permian layer were covered by basalt lava which was then uplifted and eroded. 50 million years ago a lake with red clay sediments buried the pinnacles again; they were then gradually re-exposed, emerging from the eroded bedrock as landscapes of packed sword-edge pinnacles, rock teeth and forests of close-set pillars and towers. There are depressions and dolines, more than 80 lakes, more than 50 small ponds and springs and nine underground rivers. The soils are red earth and calcareous.

Libo: Hundreds of cone-shaped hills lie in rolling country covered in virgin forest harboring great biological diversity. The region, over millions of years starting in the end of the Precambrian, experienced a series of periods of uplift and karstic erosion, marine invasion and sedimentation, several phases of tectonic activity, faulting and planation. The origin of the present landscapes was in the late Precambrian and Palaeozoic eras when limestones, dolomites and dolomitic limestones some 8,600m thick were deposited, the karst developing differently in different rocks. The present landform results from an ancient tectonic fault-fold zone with many unconformities between the middle Devonian and its underlying strata and between the upper Cretaceous strata and the underlying Permian and Triassic strata. Tectonic activity resulted in a trough fold system of parallel and gigantic box-like anticlines 30-50km wide with steep flanks, and tight synclines. In the centre of the anticlines, Carboniferous and Permian carbonates outcrop widely, middle Triassic clastic rocks outcrop in the axes of the synclines, and partial red beds in the tectonic basin. Since the Quaternary, the final phase of this long and intense karst development is the present majestic plateau-gorge landscapes of Libo which continue to form today as the Pacific and China Plates converge, uplifting the land from west to east by 760 to 600m, causing the rivers to cut deeper still. The result is one of the most diverse karst landscapes in the world.

These two sites, 15km apart, are typical of humid tropical-subtropical cone karst, rejuvenating through successive cycles of uplift, solution, deposition and erosion. They are exceptional examples of *fengkong* landscapes (of conjoined cone-shaped peaks) and *fenglin* landscapes (separated peaks on a plain). They are sited between the plateau and the lowland, with clusters of tall narrow peaks, deep dolines and flat valleys, depressions (*poljes*), plains, gorges, rivers and long caverns. *Fengkong* karst, where positive landforms outnumber negative landforms, is a combination of connected conical hills 100-300m high, and enclosed depressions, valleys and gorges, well watered and forested. *Fengkong* valleys are narrow, flat and dry, mostly bare, but in gorges incised by uplift there are steep fast-flowing rivers in narrow beds; *fengkong* depression karst is characterized by enclosed depressions. *Fenglin* karst locally consists of isolated cones to 150m high on broad and flat karst penneplains covered by thin regolith where the negative landforms outnumber positive forms. *Fenglin* depressions are large and shallow with irregular sinkholes, in some of which dolines have developed. *Fenglin* valleys are wide and flat, with alluvial deposits around their margins, many rivers, lakes, swamps, caves and wall springs. Karstification continues as the landscape is rejuvenated from open *fenglin* valleys to sunken *fengkong* depressions and to narrow *fengkong* valleys and gorges. Caves at two levels at 1100m and 800m are widespread in both kinds of karst, often truncated by erosion, with entrances anywhere in the cones. They are horizontal, long, much branched, with extensive speleothem deposits. The speleothem color indicates when they were deposited, with red speleothems dating from the Cretaceous, grayish tawny brown from the Tertiary to the early Quaternary, and grayish white-gray from more recent time. The Triassic marine sediments are rich in fossils, an outstanding example being the marine reptile *Keichousaurus hui*.

The Wulong Karst is an uplifted mountain landscape with deep gorges and dolines, natural bridges and caves containing speleothems which displays a long history of geological evolution and an unusual range of karst formations. Its three components are the Furong Cave system, the Three Natural Bridges and the Houping collapsed doline (*tiankeng*) with 15km separating each. Its 2,000m thick carbonate rocks were deposited from the Cambrian to the Silurian and again from the Permian to the Triassic periods. In the middle Triassic the area was uplifted and in the late Jurassic folded and faulted establishing the basic pattern of joints and faults. The karst is composed of a series of anticlines and synclines with the Cambrian and Ordovician carbonates outcropping on the anticlines while the Triassic and Jurassic carbonates outcrop on the synclines. The Cenozoic Himalayan orogeny led to the formation of denudation plains, deeply incised gorges and several kinds of karst. The Furong cave and exceptionally large *tiankeng* dolines developed in the Cambrian and Ordovician carbonates. The Three Natural Bridges developed in the Triassic carbonates. Soils are yellow, yellow-brown and alkaline.

The Furong Cave system has 2,846m of explored passages with chambers as high as 80m. The deposits and speleothem fragments are a valuable geological record. In it, calcite, aragonite and gypsum crystals, cave pearls, needles and helictites all grow, along with stalagmites, draperies, and stalagmites in massive, raft and palm-tree forms. The three substantial natural bridges which occur along the steep course of the Yangshuihe river are between 96 and 116m high, 28 to 34 m wide. The

*tiankengs* are the result of the collapse of giant dolines during tectonic uplift. The largest, Qingkou, is 220-250m wide, 295m deep and 40,754 sq.m in area. There are also unusually deep shaft caves such as Qikeng which is 920m deep.

## CLIMATE

The climates are humid tropical to sub-humid subtropical (Wulong). They are subject to both the temperate humid southeast and hot dry southwest monsoons, with most rain falling between May and October, and to cold air drainage from the Tibetan plateau. Winters are warm, summers are cool. Mean January and July temperatures for Shilin are 8.2°C and 20.8°C; for Libo: 5°C and 23°C; for Wulong: 11.2°C and 18.5°C. Average rainfall is in Shilin, 800-850mm, Libo, 1,752mm and Wulong, 1,105mm.

## VEGETATION

The sites contain the world's most intact subtropical karst forest, dominated by evergreen broadleaved *Castanopsis* and *Cyclobalanopsis* forest and evergreen mixed broadleaf-conifer forest of *Platycarya longipes* and *Pinus kwangtungensis*. The nominated sites are located between three biogeographical provinces, Sino-Himalayan, Sino-Japanese and East Asian, so the transitional vegetation has great variety including xerophytes, lithophytes and calciphiles typical of droughty highly calcareous lithosols. As a result it is a model of the geological, biological and ecological processes typical of the climate and soil.

Shilin: the sites contain 889 species of vascular plants, in 533 genera and 147 families with 43 species of Pteridophyte and 13 gymnosperm species. Four types of forest cover 32% of the karst: partially drought-resistant evergreen broad-leaved *Cyclobalanopsis glaucoides*, and *Castanopsis delavayi*, endemic to the southwestern karst; sclerophyllous evergreen broad-leaved forest of *Quercus cocciferoides* and *Quercus franchetti*; deciduous broad-leaved forest; and subtropical needle-leaved forest with *Pinus yunnanensis*, found throughout west China. Other vegetation types are shrublands, grasslands with occasional trees and meadows and an *Ottelia acuminata* lake community. The flora consists of the elements of three forest sub-regions: Sino-Himalayan, Sino-Japanese and East Asian. There are eight species of nationally protected plants and almost 100 rare and locally endemic species.

The Libo Karst sites contain 1,532 vascular species in 687 genera and 225 families, 144 species of bryophyte and 212 species of pteridophyte. This includes 17 gymnosperm species. The 284 tropical angiosperms genera are 40.1% of the total, 20.5% are subtropical and 35.4% are temperate. The nominated sites have amongst the greatest number of nationally protected plants of any karst area in China: 112 species, about 43% of the flora of Guizhou Province and 10% of China's total. The 18 species listed in the IUCN Red List include one critically endangered and 9 vulnerable species. The national Red List includes 7 critically endangered, 26 endangered and 50 vulnerable species, many endemic. Among the nationally protected species are 8 species in class I and 104 species in class II.

8 genera in the nominated sites are endemic to China, plus 5 endemic genera with several endemic species. To date, 41 species are recorded as endemic to Libo Karst, They include 14 tree, 12 shrub, 7 liana and 8 herb species. The threatened endemics include *Paphiopedium emersonii* (CR). Ancient and relict plants, like the ancient Gymnospermae are represented by 17 species. These are widespread and dominant on each cone summit; one, *Tetrathyrium subcordatum*, is extremely rare in East Asia and Libo is considered the center of its distribution.

The widely distributed climax communities are mainly evergreen/deciduous broad-leaved mixed forests. This forest type is extremely rare at this altitude and is of exceptionally high scientific interest. There is also a local bamboo forest of *Dendrocalamus tsiangii*. The four dominant forest types are: warm coniferous forest of *Pinus kwangtungensis*; warm mixed needle and broad-leaved forests of *Pseudotsuga sinensis* with *Platycarya longipes* and *Pseudotsuga sinensis*-*Pinus kwangtungensis* with *Quercus phillyraeoides*; evergreen and deciduous broad-leaved mixed forest of *Cyclobalanopsis glauca* with *Platycarya longipes*, also mixed forests of *Phellodendron amurense* - *Platycarya longipes*, *Platycarya longipes* - *Viburnum*, *Handeliidendron bodinieri* - *Aceraceae*, *Viburnum* - *Schefflera octophylla*, *Sterculiaceae* - *Cyclobalanopsis glauca*, *Taxus cuspidate* - *Lindera*, *Koelreuteria paniculata* - *Aceraceae* mixed forest and *Castanopsis fargesii* - *Elaeocarpaceae*.

Wulong: The steep, little disturbed Furong river gorge retains a rare and diverse vegetation where the seasonal vegetation colour changes are dramatically beautiful. There are 558 vascular plant species in 139 families and 375 genera, including 56 pteridophytes. The dominant forest is of subtropical evergreen broad-leaved trees with deciduous broad-leaved forest of *Quercus fabric*, *Quercus acutissima* and *Kalopanax ricinifolius* and *Liquidambar formosana*. The seasonal color changes are very beautiful. There is subtropical needle-leaved forest of *Pinus massoniana* and *Cupressus funebri* and temperate coniferous forest. There is also some bamboo forest and bamboo scrub, including *Phyllostachys heteroclada* and *Sinoca lamusaffinis*, and some tussock grassland. The similar vegetation of the Three Natural Bridges buffer zone is mostly secondary, but diverse, and composed of forest trees, coppice forest, shrubland and grassland. Typical protected species are *Ginkgo biloba*, *Cinnamomum camphora*, *Actinidia chinensis*, *Taxus chinensis*, *Handliodendron bodinieri*, *Liriodendron chinense*, *Juglans regia*, and *Phellodendron chinense*.

## FAUNA

In Shilin National Park there are 185 species: 42 mammal, 87 bird, 32 reptile, 12 amphibian and 12 fish species. Of these 7 small rodents and 8 bird species of birds are on the Chinese Red List. These include the Lady Amherst pheasant *Chrysolophus amherstiae*. Cave animals include bats and 11 species of cave fish. One, *Triplophysa shilinensis*, was discovered in the river in Weiboyi Cave in 1991 and only five have ever been found. Of the several Palaearctic species many are drought tolerant.

Libo: The nominated sites have an extremely diverse fauna belonging largely to the Oriental and Palearctic realms in the approximate ratio of 80% to 20%, including many that are endemic and endangered. There are 314 species\* of vertebrate fauna, including 59 species of mammal, 137 species of birds, 23 of which breed locally, 43 species of reptiles, 32 species of amphibians and 43 species of fish, including some from the Pearl River system to the south. Also recorded are 1,282 species of insects, 140 species of land snails, 146 species of arachnids and 10 species of myriapods. 45 globally threatened species live in the reserve. These include the white-sideburned leaf monkey *Trachypithecus francoisi* (VU) the clouded leopard *Neofelis nebulosa* (VU) and Elliot's pheasant *Syrmaticus ellioti*. 35 species are on the national list of protected fauna, including 3 class I and 32 class II species, some endemic to Libo. Among the first are leopard *Panthera pardus* and Burmese python *Python molurus*. 38 species are endemic to the region and to China; for instance, three endemic species of bat: great evening bat, *la io*, Szechwan myotis *Myotis altarium* and Daubenton's bat *M. daubentoni*. In recent years, 124 animal species and some 13 type species have been discovered in Libo. (\*The nomination quotes two differing sets of species totals).

In addition there are 174 species of cave fauna, including 13 species of bats, 37 species of fish, 42 species of spiders and 58 species of land snails, forming respectively 7.5%, 21.3%, 24.1% and 33.3% of the total cave fauna. There are also 10 species of myriapods, 14 other species of invertebrates, three endemic genera and 17 endemic species. Recently 20 new species of cave-adapted fauna were discovered in the Dongge cave, and many new species are likely to be found, especially amongst the cave fauna. This richness of endemics makes the Libo sites especially important to the study of local and karstic cave species.

Wulong: In these karst sites and buffer zones, especially the steep-sided forested Furongjiang valley and, Three Natural Bridges areas, human activities are limited so the area has become an animal refuge. The faunal diversity is extremely rich, totaling 332 species: 46 mammals 174 birds, 20 amphibians, 28 reptiles and 64 species of fish. Its rare animals include four species with level 1 national protection: clouded leopard (VU), white-sideburned leaf monkey (VU), Chinese pangolin *Manis pentadactyla* (EN) and golden eagle *Aquila chrysaetos*. Nineteen species on the second level of national protection include Asian wild dog *Cuon alpinus* (EN), stumptailed macaque *Macaca arctoides* (VU), rhesus macaque *Macaca mulatta*, leopard *Panthera pardus*, the viverrids spotted linsang, *Prionodon pardicolor*, and large and small Indian civets *Viverra zibetha* and *Viverricula indica*, Asiatic golden cat *Pardofelis temminckii*, yellow-throated marten *Martes flavigula*, Eurasian otter *Lutra lutra*, the forest musk deer *Moschus berezovskii* (EN) and golden and Reeves's pheasants *Chrysolophus pictus* and *Syrmaticus reevesii* (VU). The 64 species of fish found in Furongjiang include 33 endemic species. Two endemic mammals are tufted deer *Elaphodus cephalophus* and Pére David's rock squirrel *Sciurotamias davidianus*. In the Qishiercha and Xienren Caves, bats, spiders and butterflies are found, and in the waters of Xianren and Longquan Caves, tadpoles and blind fish.

## **CONSERVATION VALUE**

The three sites display spectacular intact and representative landscapes of continental subtropical forested karst weathering in an unusually great variety of both karstic forms and evidence of their complex evolution. Visually, especially in the Shilin stone forests, the effects are astonishing in their fantastic and bizarre picturesqueness. The sites lie partly within a WWF Global 200 Eco-region, and form a BirdLife-designated Endemic Bird Area.

## **CULTURAL HERITAGE**

Humans have lived in Shilin since Paleolithic times and the Sani Yi can be traced back to 300 BC. The area has long been exploited for its soil, forest, stone and mineral resources. The stone forests are intimately connected with the life of the Yi, their religion, celebrations and dance; and their extraordinary forms are a celebrated part of the artistic and garden-making heritage of China. In the Libo area the Shui people of the Maolan Nature Reserve have managed the area sustainably for at least 1,000 years, for non-timber forest products such as foods, medicines, decorative plants and craft materials; felling of useful trees and the cultivation of marshes and wetlands were prohibited by village law. The Shui have a unique asset in Shui Shu, an ancient written language with pictographic characters similar to Shang Dynasty characters carved between the 16<sup>th</sup> and 11<sup>th</sup> centuries BC on tortoise shells and animal bones. Their encyclopedic writings cover divination, local geography, ethics, religion, culture, aesthetics and laws of the ethnic group.

## **LOCAL HUMAN POPULATIONS**

In Shilin the Yi people include the Sani, Axi and Azhe, and are the dominant minority population, increasing by some 7% a year. Three of their farm villages lie within the site where they apply traditional measures for conserving their environment with little use of costly and polluting pesticides and herbicides. There are 150 ha of farmland for subsistence crops of corn, beans and potatoes and cash crops of tobacco and fruit trees, but no grazing livestock except for penned cattle in the buffer zone. In 2004, 961 people lived in the core and 4,632 in the buffer zone. In Libo the populations of the two sites and buffer zone are 5,751 and 24,747 respectively, increasing slowly. There are 13 agricultural villages and patches of some 190 ha of subsistence farmland within the core sites. Aboriginal minorities, such as the Yao, Buyi, Zhuang, Miao and Shui form 84.2% of the population, and preserve their traditional customs and methods of conservation. They depend on sustainable farming of rice, corn, beans and rapeseed with cash crops of sour plums and bamboo. They also live on hunting and collecting medicinal herbs, though eco- and folklore tourism are becoming alternatives. The Shui have great pride in their environment, especially for their techniques for preventing wildfires. In Wulong the steep gorge sides are little inhabited. However, in 2004 the core sites had 3,940 inhabitants and the agricultural buffer zones 23,993. These were to be relocated by 2020 and the land returned to forest and grass. Its character resembled the other sites'. The total population living in the three core zones in 2004 was 10,652.

## **VISITORS AND VISITOR FACILITIES**

The stone forests of Shilin have been visited for centuries. By 1988 they had 1,000,000 annual visitors, by 2005, 2,050,000, and numbers may soon have to be limited. At present to minimise impacts, guided tours are staggered and only certain areas are open to tourists. The minority peoples are supported by government partly for their contribution to tourism: the Yi people entertain visitors with their music, dance, athletic games and costumes, providing one of the distinguishing attractions. There are 16 km of signed trails, the Stone Forest Museum, a visitors' centre with restaurant, 30 shops, 300 guides, 3 search & rescue teams and accommodation outside the core area. An educational museum is planned and tourist facilities and waste disposal are to be improved and moved outside the core area. There is train access to Shilin from Kunming.

In Libo, annual tourist numbers increased from 100,000 in 2000 to 280,000 in 2004. By 2020 they may be over one million and their movements and vehicles must be carefully controlled. High class tourism resources are available: 34 km of signed trails, 35 guides, cave exploration and climbing, a visitors' centre, educational ecotourism, 4 restaurants, shops and two help & rescue centres. There is nearby accommodation and a visitors' centre and museum are planned. As in Shilin, the Yao people welcome and entertain the tourists, and have a high-profile welcoming ceremony where men, dressed in homespun, fire a gun salute.

Visitors to the Furong and Three Bridges areas in Wulong totaled 100,000 in 2000 and 380,000 in 2005. However the road to Three Bridges is narrow and the space in Furong cave is limited. Half the cave passages are out of bounds to the public and only 2.5 km of the gorge is open. There are 45km of signed trails, 28 guides, a museum at Three Bridges, 3 visitors' centers, 3 restaurants, 12 shops and 3 search and rescue teams, mostly now moved out of the core zones. There is accommodation for over 500 outside the area. Each site has ample published information.

## **SCIENTIFIC RESEARCH AND FACILITIES**

The sites are an ideal natural experimental base for studying cone karst forest ecosystems and caves, for historical extrapolation and education about them. Over 20 foreign and domestic research institutions have worked on the sites since they became known in the 1980s and cavers from ten countries have explored over 120km of cave passages. The Lunan Stone Forest of Shilin has long been investigated and much written about: one stalagmite for instance, in Dongge cave in Shilin, has been analysed to give a continuous record of variations in the Asian monsoon over the past 9,000 years. The richness of endemic species makes the sites important to the study of the regional flora and fauna, and of their development and evolution in karst ecosystems. The history, people and economic opportunities of the region have also been studied. Despite its having been discovered quite recently, 300 articles have already been published on the Libo karst and it has become a center for karst research. Both it and the Wulong karsts may yield many new species, especially of cave fauna. A Stone Forest Research Centre was established in Shilin in 1999, the Maolan Reserve has an experimental zone for research and education and Wulong County has funded a scientific foundation and a subsidiary institute for karst research.

## **MANAGEMENT**

The sites are protected under the state constitution and laws on Environmental Protection 1989, Protection of Wildlife, Forestry and Water, all of 1988 and Regulations for the management of Scenic & Historic Areas 1985 and Nature Reserves 1994; each site is also protected under specific provincial regulations. They are managed under the aegis of the State Ministry of Construction and (Libo) by the State Forestry Bureau, but each province, city or prefecture also has its own management agency, as do the Reserves themselves. Shilin has the Management Bureau of Shilin National Park. Libo is managed by the Management Bureau for Libo Karst National Scenic Area and Nature Reserve, by the administrations of Libo Autonomous County, Maolan National Nature Reserve, Zhangjiang Scenic and Historic Area, and the local communities. Wulong is managed by the Furongjiang Scenic and Historic Area Administration.

A 20-year (1982-2002) master plan for Shilin was approved in 1987, and updated for 2003-2020 in 2004. This details specific Heritage sites and four conservation zones with lessening degrees of prohibition: Special Protected zone which is closed to all uses plus the First Class Protected zone, open to licensed scientists and landscape restoration, which comprise the core, Buffer or Second Class Protected zone, and Proving/Tourist-Service or Third Class zone. It is augmented by detailed guidelines for resource protection, for implementing the World Heritage Convention, and for the protection of caves and karsts. Most of both sites are in excellent condition despite heavy visitation. Libo karst forest was discovered and surveyed between 1975 and 1985. A master plan is to be drawn up to protect all features of the karst, karst forest ecosystems, endangered species and their habitats and scenery. This will start with an inventory and assessment of the landscape and structures. Strategies are projected for rural development and land use, economic development and fruit tree planting, research and monitoring, community participation and staff training, awareness-raising and publicity. The Maolan National Nature Reserve and the Daqikong and Xiaoqikong sectors of the Zhangjiang river National Scenic and Historic Area with their master plans were incorporated in 1989. Zhangjiang reserve has the same four zones; Maolan also has four: core, buffer, experimental (for ecotourism and research), all in the Libo karst site, and peripheral, in the buffer zone. The managing agency and management proposal for Libo were ratified in 2005. The reserve is in good condition at present but the administrative capacity is stated in the nomination to be low. There is a possibility of future extension of the east site into Guangzhou province so the buffer zone is omitted along the provincial border. Wulong is in good condition. Its buffer zone is to be extended to protect 60,000ha of the upper catchment area of the river, lack of resources preventing protection of the whole catchment.

The government recognises the rights of minority cultures to their land and traditional languages and that they have managed their land sustainably in the past, but they are to be helped to adjust to



change. Generally the aim is to prohibit nearly all uses in the core areas, to restore and augment the native vegetation, to develop and maintain facilities in conformity with the character of the area, and to regulate all activities in the buffer and peripheral zones in cooperation with the local people. In the core sites quarrying and mining, tree-cutting and deforestation, hunting, setting fires, grazing, land reclamation and building are prohibited. In buffer zones vehicles, human impacts and multiple uses are to be controlled; existing industries will be gradually removed, and slopes over 25° reforested. Measures are taken to control floods and wastes and conserve soils upstream. The flora and fauna and natural ecological communities are to be restored, farmlands in all three core zones being restored to grassland or forest, and the effects of tourist numbers controlled. Monitoring the condition of the sites is taken seriously in view of the importance of tourist safety, notably of geological condition, especially the caves, also of fires, floods and water quality, species and biodiversity, invasion by alien species, communities and land uses and the numbers of visitors. Remote sensing and video surveillance of main trails are used.

The Mulun National Nature Reserve in Guangxi, adjacent to Libo, is nearly all forested karst of very high geological and biological quality. It is to be nominated for World Heritage status in Stage II of this nomination in 2008, together with the disparate sites of Xingyi in Guizhou, Jinfoshan in Chongqing and Yangshuo in Guangxi - a type locality for *fenglin* tower karst and of the national tradition of landscape painting. There are the prospects of a future Stage III including a transboundary site with the equally rich forested karst of northern Vietnam.

### **MANAGEMENT CONSTRAINTS**

The core areas have been well preserved both by inaccessibility and by their tribal peoples. The expanding agricultural population round the three sites is stressing the buffer zone and in places beginning to encroach on the core. There is some threat from earthquakes, forest insect pests, invading *Eupatorium coelestrum*, fires (set to improve the grazing) and both drought and occasional floods. Wulong is also threatened by mudflows and rock falls. Intensive cave tourism may threaten their biological resources.

### **COMPARISON WITH SIMILAR SITES**

The South China Karst of which these sites are the most eloquent representatives extends over 600 km of area and 2,000m in elevation from the Yunnan plateau to a tributary Yangtse gorge. They consist of continental subtropical limestone weathering which exhibits an unusually great variety of both karstic forms and of evidence of their complex geological evolution. Visually, especially in the Shilin stone forests, the effects are astonishing in their fantastic and bizarre picturesqueness. Other areas of karst in temperate and alpine China are not easily comparable with these complex humid subtropical examples. Of 47 World Heritage sites 12 are inscribed for their caves and karst; 26 inscribed for other reasons have cave and karst features, and nine Cultural sites contain similar elements.

The three sites have been nominated for all four natural World Heritage criteria. Designation as a site of globally significant continental subtropical forested karst of outstanding historical geological interest, ongoing processes and phenomenal scenic quality (categories vii and viii) is difficult to refute except perhaps for Wulong where the exceptional cave is rivalled in several of the sites listed above. Designation for importance for ongoing ecological processes and biodiversity of habitats and biota (categories ix and x) is clearer on the national than the global scale.

### **STAFF**

The current fulltime staff for the three sites is: in Shilin 109 professional and 89 management personnel plus 10 part-time security staff; in Libo, 30 professionals, 72 other fulltime staff plus 500 part-time staff; and in Wulong a total of 101. In Shilin the Yi people provide park staff and management for the park. Staff training is planned.

### **BUDGET**

Funding for all sites is adequate. In 2004 the budget was RMB245,000,000 (US\$29,500,000). 64% of this came from entry fees, 14% directly from central government, 8% for projects and 13% from other sources such as county and municipal governments and donations. For Shilin in 2005, entry fees totalled RMB160,000,000 (US\$19,254,000); RMB1,630,000,000 (US\$196,149,000) had been earmarked for landscape rehabilitation and visitor facility projects over the period 2002-2010. For Libo, a total of RMB267,538,200 (US\$32,233,000) is expected to cover operation of the Park between 2005

and 2010, 40% being for protection, 17% for research and exhibition and 12% for ecological restoration. For Wulong the annual budget is RMB20,000,000 (US\$2,409,600), 13 million from Chongqing People's Government, 6 million from Wulong People's Government and 1 million from entry fees.

## LOCAL ADDRESSES

Ministry of Construction of People's Republic of China, No.9, Sanlihe Road, Beijing 100835, China.

Construction Department of Yunnan Province; World Heritage Management Committee of Yunnan Province, No.129, Xichang Road, Kunming 650032, Yunnan, China.

Construction Department of Guizhou, Guiyang City 550002, Guizhou, China.

Office of World Heritage Application and Management of Guizhou Province, Guiyang 550001, Guizhou Province, China.

Garden Bureau of Chongqing City; World Heritage Management Committee of Chongqing City, No.179, Eling Street, Yuzhong Region, Chongqing 400014, China.

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