



Typical karst landscape in Daxin County, Southwest Guangxi, China. Credit: Huang Bo/IBE ▲

## SECURING THE FUTURE FOR ASIA'S STUNNING KARST ECOSYSTEMS

### A briefing by **Fauna & Flora International**

Some of the most beautiful and memorable landscapes in Asia are in 'karst', a limestone formation in which erosion has produced steep slopes, fissures, sinkholes, underground streams and caverns. The steep karst hills and caves attract large numbers of tourists to places like Ha Long Bay (Vietnam), Guilin (China), Maros/Bantimurung (Indonesia), Krabi, Ao Phang-nga and 'James Bond Island' (Thailand), Puerto Princesa Subterranean River National Park (Philippines) and Phou Hin Poun (Lao PDR).



Beautiful karst scenery in Nonggang National Nature Reserve in Southwest Guangxi, China. Credit: Zhao Wenqing/IBE ▲

## Uses of Limestone

Limestone is an extremely important raw material, the main use of which is in the construction industry. The rock is an essential resource for cement manufacture, as crushed rock aggregate, and also as a source of building and ornamental stone. It is relatively cheap, versatile and can be found in many countries. Limestone is of major importance in economic development, with the production of cement even used as a barometer of growth and progress. In many infrastructure projects – such as dam and bridge construction, port development, buildings, and road building and upgrading – the extraction of limestone is a fundamental, and in most cases irreplaceable, development activity.

## Cave Systems

The most notable feature of most karst hills is their caves. Caves don't tend to be well-liked ecosystems, thanks to being extremely dark, often quite cramped and slippery and home to creatures which are the stuff of nightmares such as giant long-legged centipedes and spiders. With no plants, the energy to 'drive' the cave comes either from guano from the echo-locating birds and bats, or from water sweeping through in subterranean rivers or percolating from the surface. With the exception of the rise and fall of the rivers, the cave environment is quite stable and many species will perish quickly if the prevailing regimes of high humidity and darkness change.

Karst cave in Wuchuan County, Guizhou, China. Credit: Xu Jian/IBE ▼



Cave Millipedes eating a dead cricket, Maros, Sulawesi. Credit: Jean-Yves Rasplus ▼



## Karst Biodiversity

The biodiversity of limestone ecosystems, both on the surface and in cave systems, is highly characteristic and restricted to these habitats. The species are adapted to cope with the highly alkaline environment and exceedingly dry soil conditions over part of the year. Many species are confined to (or found primarily inside) limestone caves. Remarkably, some species are confined to single hills or cave systems.

In some areas, such as Puerto Princesa in Palawan, Philippines, the karst areas enter the sea and underwater coastal 'anchialine' caves can be found with their own remarkable fauna.

Many of the species most in need of conservation attention are relatively small and little-known invertebrates, very few of which are dealt with in the IUCN Red List of Threatened Species. Yet it is clear that the status of many limestone-restricted species is perilous and many have surely already gone extinct as a direct result of economic development.

Due to the extreme darkness, many of the special cave animals have evolved to lose their eyes, pigmentation and flying ability, as well as developing long antennae and legs to compensate for their lack of sight. The sightless organisms include fishes, spiders, leeches, shrimps and beetles.

Cave-restricted species continue to be discovered in virtually every newly-surveyed tropical karst but Asia seems to be the richest of all. Indeed Fauna & Flora International (FFI) has contributed to the World Bank/Global Environment Facility project in Guangxi where the caves are believed to be the richest anywhere in the tropics for cave-adapted species. The large number of new cave species found across Asia underlines just how few of the caves and hills have been explored and adequately collected. Many new species are found in the process of planning new infrastructure which threatens to damage the habitats. Mere description rarely gives any great clue to the management needs of the species concerned. In all these aspects, we are obviously at the dawn of the biological exploration of tropical cave biodiversity.

Cave Whip-scorpion, Maros, Sulawesi. Credit: Louis Deharveng ▼



Karst cave in Wuchuan County, Guizhou, China. Credit: Xu Jian/IBE ▼



Blind cave fish, southern China. Credit: Prof. Zhou Jie ▼





*Rhinolophus yunnanensis*, in Guangxi. Credit: Zhao Chao/FFI ▲

## MAMMALS AND BIRDS

The most abundant and most conspicuous animals of tropical caves are species which are not restricted to subterranean environments but spend just part of their lives in caves, either seasonally or daily. The best known of these are bats. Tropical caves often host huge bat colonies with millions of individuals. The most common mass-roosting species is the wrinkle-lipped bat (*Chaerephon plicata*). Most bat species, however, live as scattered individuals or small groups in caves. Other notable species include the smallest mammal in the world, the bumblebee bat (*Craseonycteris thonglongyai*) from western Thailand and southern Myanmar, and the bizarre naked bat (*Cheiromeles torquatus*) from Sumatra and Borneo.

Cave-nesting swiftlets also echo-locate and are able to roost and nest in caves. Their nests are an extremely valuable commodity used for 'bird's nest soup' – indeed, weight for weight their nests are more valuable than gold. Bats can also have major importance as both important pollinators of various commercial tree crops (especially the famous durian) and major predators on damaging or dangerous insects.



Endangered Cao Vit Gibbon found in N. Vietnam and S. China. Credit: Zhao Chao/FFI ▲

The limestone vegetation of the hills shelters a range of interesting animals, some of which like the bald-headed bulbul (*Pycnonotus hualon*), limestone leaf-warbler (*Phylloscopus calciatilis*) and Laotian rock-rat (*Laonastes aenigmamus*) have been discovered only recently in Lao PDR. The last of these is a peculiar beast which, when first described in 2005, was thought to be the single-known species in an entirely new family of rodents. The following year it was found to belong to a family which had been thought extinct for 11 million years. Justifiably it has become known as "the coelacanth of rodents", after the ancient fish. In the same area of Lao PDR as these two species lives the karst dependent and highly charismatic Lao langur (*Trachypitecus laotum*), found only in Lao PDR. Throughout the region, karst-dependent primates have become specialized to the unique conditions provided by karst, which, in combination with habitat loss, has tragically led to them becoming some of the most endangered animals on Earth.

Endangered White-headed Langur, Guangxi, China. Credit: Guo Liang /IBE ▼



## SNAILS

Snails are rarely considered but on karst hills they reach the peak of their diversity and abundance. Limestone is calcium carbonate, a crucial component of snail shells. Many of the snails are extremely beautiful and unusual, and a large number have extremely restricted ranges. There are likely about 2000 species found only in Asian karst environments; the snail fauna of a single, undisturbed karst hill in Asia averages about 60 different species, and may reach over 100 species. Our knowledge of Asian snails is limited but there are some remarkable species: a species from western Indonesia and Malaysia has a luminescent body; some species are able to creep at extraordinary speed (for snails), or even to jump when threatened. A Philippine species emits a high-pitched squeak when disturbed. Some western Indonesian species, living on the foliage of trees, construct nests hanging from a branch by folding together two leaves. One group of species in the Pacific lays one egg at a time and bestows great parental care on the young. Plus, their ecological importance is considerable: snails act as herbivores, omnivores or carnivores, and are also preyed upon by many amphibians, snakes, birds and mammals.

## FLORA

The flora of limestone hills grows in shallow soils which tend to be deficient in various nutrients and water, especially if on an exposed hill side. In addition, high temperatures and exposure require the plants to have strategies for surviving acute drought. Yet it is the presence of many narrow endemic – meaning only existing in one area – species which gets the most attention. Among these, the gorgeous slipper orchids (*Paphiopedilum* spp) can command thousands of dollars per plant when traded on the illegal market. Also of note are the stout cycads (primitive, palm-like trees) and low fan palms. Many of the plants are capable of recovering even after severe wilting.



Everettia snail, Borneo. Credit: Jaap Vermeulen ▲



Endangered *Paphiopedilum hirsutissimum* Orchid. Credit: Xu Jian/IBE ▲

## Threats

Karst can provide an important haven for biodiversity. Its steepness makes it relatively inaccessible and unsuitable for conversion to other land uses, such as agriculture or tree plantations. Many species are now confined to karst forests due to loss of other forest habitat. This is certainly FFI's experience in primate conservation in the region. However, the threats to karst are growing. Forest loss through felling and fire, mining, pollution, guano exploitation, hunting and unsustainable tourism such as destructive 'show caves' all put pressure on this fragile ecosystem. Forest on karst is particularly vulnerable due to the shallow soils and rapid drainage, and even slight levels of initial degradation can cause a downward spiral of ecological conditions leading to a phenomenon known as 'rock desertification' from which forest recovery is virtually impossible. In addition, the loss of a cave's bat population can have serious knock-on effects on other species due to the lack of fresh guano vital for the cave's ecosystem.

Quarrying small and remote hills to the ground is the fastest way to cause the extinction of a large number of the rarest subterranean, restricted range species of invertebrates. The selection of quarrying and mining sites ought first to take into account the size and isolation of the ecosystem that will be impacted, as no remediation will be possible afterwards. This needs to be the cardinal rule for a sustainable exploitation of limestone in the tropics in terms of its impact on biodiversity.



*Hipposideros larvatus*, Guangxi. Credit: Dong Lei/IBE ▲

## Fauna & Flora International and Limestone Conservation

For over 15 years, FFI has been actively conserving some of the best karst areas in Asia. Examples include:

- Running a long-term programme for landscape conservation of a major limestone range southwest of Hanoi, comprising Cuc Phuong National Park and Ngoc Soc and Pu Luong Nature Reserves, in which FFI worked with villages and governments to better plan land and resource use, promoted appropriate tourism, and conducted biodiversity surveys
- Organising workshops and trainings on karst management for government and civil society in Vietnam
- Delivering cave surveys, karst management plan and a beautiful book for Guangxi Province, China
- Providing long-term technical and financial support for the conservation of endangered orchids and primates (e.g. Hatinh langur, restricted to limestone areas in central Vietnam/Laos) in Phong Nha – Ke Bang National Park and support for its nomination as a World Heritage Site and for trans-boundary conservation collaboration with Lao PDR
- Supporting the Biosphere Reserve nomination of the karst-rich Cat Ba Island, Vietnam, for ecotourism development in Ha Long Bay (during which FFI discovered a new species of fish restricted to one small cave pool on one of the islands), and for biodiversity surveys, karst specific management planning, and the establishment of an environmental awareness programme for Ha Long Bay World Heritage Site
- Exploring caves, including the discovery of new species (such as the tube-nosed bat *Murina eleryi*), and researching how best to safeguard their unique biodiversity
- Implementing the long-term conservation of critically endangered primates (such as the Cao Vit gibbon, *Nomascus nasutus*, Tonkin snub-nosed monkey, *Rhinopithecus avunculus*, and several langur species) and trees (such as the golden cypress, *Xanthocypris vietnamensis*) in northern Vietnam and China
- Establishing a programme for coordinated and trans-boundary habitat restoration on karst on the China-Vietnam border in order to secure the future of the Cao Vit gibbon
- Surveying biodiversity in the Khammouane Limestone/Phou Hin Poun National Protected Area in Lao PDR and planning community-based conservation that builds from the potential of karst and Lao langur-focused ecotourism
- Enhancing biodiversity conservation and management capacity of stakeholders in Puerto Princesa Subterranean River National Park in Palawan, Philippines
- Working with local communities to conserve the karst forests of Tabunan in central Cebu, Philippines, thought to be the sole remaining habitat for some of the world's most endangered birds including the Cebu Black Shama (*Copsychus cebuensis*), and the Cebu Flowerpecker (*Dicaeum quadricolor*)
- Carrying out a biodiversity assessment and management recommendations for a limestone quarry area licensed by Holcim, a global leader in cement production, on Nusa Kambangan Island, Java.

## FFI and Our Work with the Cement Industry

FFI has invested substantive effort over the past 15 years in improving the operating practices and Corporate Social and Environmental Responsibility of extractive industries. FFI has worked with multinational extractive sector companies across the world and has an intimate understanding of the issues and impacts (and risks and opportunities) relating to mineral extraction in diverse environments.

Most recently FFI has worked with Holcim to carry out a biodiversity assessment and management planning for one of the quarry sites in a sensitive area. FFI applied the High Conservation Value Forest Assessment methodology to the karst landscape – believed to be the first such effort in this ecosystem – with the aim of developing karst biodiversity management plans for both Holcim’s contract of work area as well as for the overall karst landscape of the island. The FFI cave surveys there are now the most thorough for any cave in Java. Some 98 cave species were found during the surveys, about 40 of which are likely to be new to science. Many of the specimens collected have added greatly to the knowledge of caves in Asia, as well as adding to the known distribution, the ecological tolerances and other biological criteria of the taxa. A management plan for the caves is being completed.

FFI recognises the importance of limestone quarrying for both the global economy and the economic growth of certain developing countries with significant karst areas. We believe in ensuring the use of karst limestone is carried out in a way that causes the least harm to biodiversity. In fact, research linked with company operations can benefit biodiversity by furthering scientific understanding and subsequent conservation activities. FFI will continue to work with governments, companies, and local experts and communities to further our goal of effective biodiversity management across Asia’s unique karst landscapes.

## Sources

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Credit: Xu Jian/IBE ▼



IF YOU HAVE  
ANY QUESTIONS  
OR WOULD  
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INFORMATION  
ABOUT  
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## Our Vision

A sustainable future for the planet,  
where biodiversity is effectively  
conserved by the people who live  
closest to it, supported by  
the global community

## Our Mission

Fauna & Flora International acts to  
conserve threatened species and  
ecosystems worldwide, choosing  
solutions that are sustainable,  
based on sound science and take  
account of human needs

The threatened tree *Excentrodendron tonkinense* is found on karst in N Vietnam where the endangered Tonkin Snub-nosed Monkey uses its flowers for food. ▼



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