



NEWS

Letting 1000 Forests Bloom

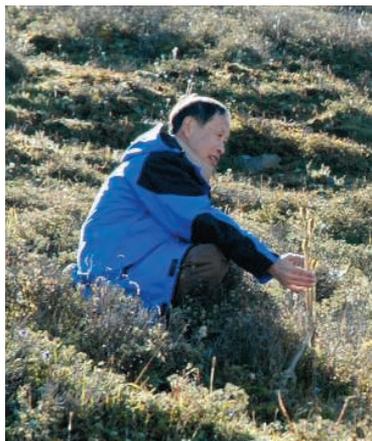
A logging ban has allowed a hot spot of China's biodiversity to recover from decades of clear-cutting, but threats still loom

In 1972, Yin Kaipu, then a young ecologist, hitched a ride aboard a loaded logging truck to a village at the base of the spectacular Qionglai Mountain Range in China's Sichuan Province. To keep from falling off, Yin and his professor, Liu Zhaoguang of the Chinese Academy of Sciences' Chengdu Institute of Biology (CIB) in Sichuan, wrapped their arms around the logs as the truck lurched down the winding dirt roads to the headquarters of the government-run logging company. What they saw was disheartening: The mountains along the road and close to the village were "shaved like a monk's head," Yin said, recalling his professor's dismay at the extensive clear-cutting.

"He knew that many special plants were being lost," along with the "habitat of many species," says Yin. The logging also posed a threat to a Chinese icon, the giant panda (*Ailuropoda melanoleuca*), which lived in small, isolated parts of the mountains' dense bamboo forests. Decades later, Premier Zhu Rongji echoed Liu's concern, decrying the Sichuan loggers as "tigers eating the whole sheep" when he toured these and other ranges in westernmost Sichuan in 1997.

Together, the ranges make up the 700,000-square-kilometer Hengduan Mountain Region, home to the world's most biologically diverse temperate forest, hosting 40% of all of China's plant species. Today, thanks in part to efforts by Yin and many others, the "logging tigers" have been tamed. After two devastating floods, the Sichuan government imposed a logging ban in 1998. Much of the region is being preserved in parks and reserves. And under a national program, local farmers are being rewarded for planting trees on fragile slopes.

But Hengduan's natural forests are not yet



Hengduan rarities. Ecologist Yin Kaipu fought to preserve the Hengduan's local plant diversity, including the regal lily (right), which has become a prime garden plant.



◀ **Recovering.** Now protected, the forested home of the giant panda has been coming back.

out of the woods. The logging ban is due to expire in 2010, and economic and population pressures still loom as threats to the recovery of the region's forests. What happens to this unique ecosystem could be an indicator of the prospects for other parts of China that have been ravaged by rapid industrialization and population growth. "The end of the logging was the first step," says Yin. "The challenge is finding a balance between people's needs and protecting the forest."

Logging legacy

China's Hengduan Mountain Region lies more than 1500 kilometers southwest of Beijing. (It is at the epicenter of the devastating earthquake that struck Sichuan last month; see *Science*, 23 May, p. 996.) "The Hengduans are like islands," says botanist John Simmons, the retired curator of Britain's Royal Botanic Gardens, Kew, who has collected extensively in the region with Yin. "They're isolated, with a range of ecological niches, from lower [600 meters] to higher elevations [more than 6000 meters]," spurring plants "to speciate like mad." They house 3500 endemic species of plants, birds, reptiles, amphibians, and mammals, including giant pandas. That's made this part of China a prime target of plant collectors and botanists since the late 19th century. "Nearly every garden today" has a plant from there, says Simmons, most likely a rhododendron, primrose, or lily.

But beginning in the 1950s and intensifying in the 1970s, loggers devoured the dense forests—part of the country's spurt to become an industrialized nation. The clear-cutting, which Yin and Liu witnessed throughout the

Hengduans as they mapped and collected the region's flora, inflicted huge damage on the ecosystem. "Without a forest to protect the soil, we knew a flood would come," says Yin.

Ultimately, two catastrophic floods came, in 1981 and 1998, on the upper and lower portions of the Yangtze River. The second flood—a disaster that killed more than 1500 people, left millions homeless, and cost some \$20 billion—finally spurred the Sichuan government to ban logging in its natural forests. The next

CREDITS (TOP): DILLIC/CORBIS; (BOTTOM LEFT TO RIGHT): DIANE XA; WIKIPEDIA

year, China started to replant and preserve forest lands nationwide. These moves were “a major milestone,” says ecologist Jianguo “Jack” Liu of Michigan State University in East Lansing, whose analysis of the recovery will soon appear in the *Proceedings of the National Academy of Sciences*.

However, the damage done before the ban was extensive. Some 20% of the region’s plant species are now endangered, and much of the panda, takin, and golden monkey habitat was lost to logging. When the clear-cutting finally stopped, “roughly 35% to 40% of Sichuan’s natural forests were gone,” says forest ecologist Mu Changlong, deputy director of the Sichuan Academy of Forestry in Chengdu. And in some parts of the province, more than 85% of the forest was cut, even in places that the government had identified as important for soil and water conservation. “The timber companies worked in areas that were the most accessible, with the largest trees and most biodiversity,” says Mu. “In some places, they logged everything up to 3000 meters [in elevation].”

Theoretically, the loggers were supposed to be followed close behind by planters. “But the loggers were faster, so in many places the clear-cuts weren’t reforested, and now there are just bushes and sword bamboo,” which inhibit the growth of the original conifer forest, says Mu.

Worse, in some areas, such as along the Upper Min River in the Hengduan’s Min Mountain Range, the vertical terrain was so completely deforested and eroded that getting anything to grow now is “impossible,” says ecologist Wu Ning, CIB’s executive director. “We’re simply trying to stop the expansion of what has become a desert” by building fences to keep the soil from sliding into the river, says Wu. Sichuan has now reduced its soil erosion by 1.5 billion tons, but eroded sediments in the Upper Yangtze still clog so much of the river that only ships between 5000 and 8000 tons can navigate this far upstream.

Efforts continue, as well, to bring back forests. Overall, 143,000 hectares have been replanted along the damaged Min River gorge, primarily with exotic red pine (*Pinus tabulaeformis*), a fast-growing species from northern China. But 13,300 hectares of this total have been reforested with a CIB-recommended mix of native broadleaf and coniferous species, as well as exotics, in an effort to avoid the health and fire-prone problems associated with single-species stands, says Yin. And to further relieve the pressure on native forests, the government plans to plant 2.5 billion trees in plantations

this year throughout the country. It wants to become self-sufficient in timber by 2050.

China has also provided economic incentives to farmers. In 1999, it initiated the Grain for Green Program, paying farmers to plant trees and shrubs on agricultural land with more than a 25-degree slope, with the goal of increasing plant cover by 32 million hectares by 2010 (*Science*, 7 December 2007, p. 1556). “That helped the people, especially those who lost jobs because of the [logging] ban,” says conservation ecologist Ling Lin of the World Wide Fund for Nature in Chengdu. And under the 2002 Rural Contract Law, farmers now own the rights to what they grow, which “should help them better manage the land in a sustainable manner,” says Xu Jintao, an economist at Bei-



China’s treasured forest. The Hengduan Mountain Region contains the world’s most diverse temperate forest.

jing’s Peking University. They can use the rights as collateral, pass them on to their children, and even sell them.

Moreover, in Sichuan, 75,000 square kilometers—about 15.5% of the province—of the natural forests are now safe in approximately 150 reserves or provincial and national parks, such as Siguniang (Four Sisters Mountain) National Park in the Qionglai Mountain Range. Two, Wolong Nature Reserve and Jiuzhaigou, where dense stands of native conifers edge more than 100 turquoise-colored lakes, are now World Heritage Sites.

Fragile progress

But concerns remain. China is now the world’s largest manufacturer and exporter of wood products and has an enormous demand for the raw material. “The price of timber in China

has increased two to three times over the last 5 years,” says Xu. Should the Grain for Green Program subsidies end, the temptation to cut the trees will be huge, warns Jack Liu. That’s why, he and others say, China has recently extended the program and may do the same for the logging ban, at least for the natural forests. In the more remote regions of the Hengduans, people continue to cut trees for fuel and home construction, notes Harvard University botanist David Bouffard.

The preserves themselves are facing another threat. “From the first day, these parks have been very popular,” says Yin, adding that they now draw millions of visitors annually. “It is too many.” More than 30,000 tourists can wander through Jiuzhaigou on a single day, despite requests from Yin and other ecologists to limit that number. “It’s just a sea of people at the entry gate some mornings,” adds Jack Liu, noting that in Jiuzhaigou the only panda “sightings” are occasional scat. “There are just too many people and too much noise,” he complains.

With a government grant in hand, Yin is now looking for ways to relieve the pressure. One solution may come from his team’s 2006 proposal to connect two of the largest panda reserves in the Min Mountain Range by restoring some 30 to 40 square kilometers of panda habitat.

Yin and others are also helping the State Forestry Administration set zoning limits, denoting some park areas for mass tourism and others for more individual experiences such as wilderness backpacking, and even closing a few altogether. One morning at Siguniang, where a zoning system now exists, Yin walked contentedly along a boardwalk trail through a wetland meadow, pointing out the endemic flowers and shrubs he and his professor had collected more than 30 years ago. On either side of the meadow rose snow-capped peaks, their flanks thick with the classic mixed forest of western Sichuan. “The logging tigers didn’t get this far up the valley because there was no road,” says Yin. There is a paved road now. But with luck, the zoning system will help Siguniang’s forests survive the growing number of China’s tourist tigers.

—VIRGINIA MORELL