

Extinguishing pain's flame

Some researchers argue that the clinical uses of PET and fMRI won't be limited to diagnosing brain disorders. In the 20 December 2005 *PNAS*, neuroscientists reported using fMRI to teach people with chronic pain to monitor and control their own brain activity—a high-tech version of biofeedback. The research team included scientists from Stanford and the Massachusetts Institute of Technology and was led by Christopher deCharms, a neuroscientist and president of Omneuron, a start-up company in Menlo Park, California.

Each patient slid into an fMRI scanner and watched a computer-generated flame flickering on a monitor. The intensity of the flame reflected, with a few seconds' delay, neural activity picked up by the scanner in the patient's right anterior cingulate cortex, a region implicated in pain perception. The patients who best learned to minimize the flame reported the greatest reduction of pain symptoms immediately after the session. Another group of patients whose flames were fed by neural activity in their posterior cingulate cortex, an area not associated with pain processing, showed no such reduction.

"I thought this was enormously clever," says Raichle. Biofeedback has been tried previously for chronic pain, he says, but this is the first attempt to specifically target the brain regions that process pain. DeCharms's team is now doing a larger trial with weekly neurofeedback sessions for pain patients and following up to see how long the effect lasts.

Omneuron is also experimenting with real-time fMRI to assist psychotherapy. The firm's preliminary work has been in people with obsessive-compulsive disorder (OCD). Last year, at the annual meeting of the Organization for Human Brain Mapping, deCharms and colleagues described the method. Patients with OCD lie in the scanner, where they see the computer-generated flame, as well as a video link to their therapist, who sits in the control booth and also keeps an eye on the flame.

It's far too early to say whether the method will work. One of the central challenges, deCharms says, is determining the best brain areas to fuel the flames. Fortunately, he adds, functional neuroimaging methods such as fMRI have already provided many clues about what regions are involved in many psychiatric disorders. "The big question for us is, 'How can we take this nearly 20 years of research and turn it into clinical applications?'"

—GREG MILLER



Priceless. Changbai's stunning vistas are drawing increasing numbers of tourists—and increasing pressures on the landscape.

ECOLOGY

A Threatened Nature Reserve Breaks Down Asian Borders

Chinese and Koreans share a love of Changbai Mountain, which straddles their border. Now that the area is under threat, the two sides may join hands to save it

CHANGBAISHAN NATURE RESERVE, CHINA— To many Chinese, Changbai Mountain, whose jagged volcanic summit cups a crater lake on the border of North Korea, is the fatherland of Manchurian emperors who rose to power during the Qing Dynasty 4 centuries ago. Koreans, meanwhile, revere the iconic peak, which they call Paektu, as the birthplace of their culture and the nerve center of resistance to Japanese colonial rule in the 1930s and '40s. For scientists, Changbai is precious for another reason: It's a unique set of ecosystems under siege. Now, a new Chinese initiative aims to save it.

Changbaishan Nature Reserve, the largest protected temperate forest in the world, is home to endangered Siberian tigers and the last stands of virgin Korean pine-mixed hardwood on the planet. It's "one of the most spectacular and relatively undisturbed ranges in China," says Burton Barnes, a forest ecologist at the University of Michigan, Ann Arbor, who conducted research here in the 1980s and early '90s. But aggressive logging along the reserve's Chinese edge, and conversion to croplands on the Korean side, threaten to turn Changbai into "an oasis in a sea of clear-cutting," says Wang Shaoxian, director of

the Jilin Changbai Mountain Academy of Sciences (JCMAS).

The reserve, roughly half the size of New York's Long Island, is also under increasing pressure from the inside. Chinese hot-spring resorts and Korean revolutionary museums on Changbai's flanks—the rugged, isolated terrain provided cover for the resistance—have transformed the reserve into a tourist mecca.

Hoping to counter these threats to the fragile ecosystems, the Chinese government this year designated Changbaishan, or "Perpetually White Mountain," as a major research initiative in its latest 5-year plan. It's pouring money into new facilities and projects, including a biodiversity survey and a study of how to better manage the Changbai ecosystems. The venerated mountain may also become a symbol of science transcending boundaries. Chinese and North Korean forest ecologists, who have had scant contact in recent years, are discussing the potential for collaborations at Changbai. From the vantage of local authorities, such cooperation "would be incredibly possible," says Ding Zhihui, deputy director of the Jilin Changbaishan Protection, Development, and Management Committee.

A research stint at Changbai has long

been a rite of passage for many Chinese researchers. Biologists, volcanologists, and meteorologists would winter at a cliff-hugging station with stunning views of Heaven Lake (in Korean, Lake Chon). “That time of year, it’s like the North Pole here,” says Dai Limin of the Institute of Applied Ecology in Shenyang. Temperatures can plunge below -40°C , and heavy snowfalls make the winding road up the peak impassable for months. Only in 2001 did the hardy winter crews finally yield to automated stations. Year-round observations, especially volcanic monitoring, are critical, says Wang. Changbai has been quiet since minor eruptions in 1597, 1688, and 1702. “It’s due,” Wang says. Chinese spas are deemed within striking distance of future lava flows.

Once the snow melts, the highlands teem with researchers. The Chinese Academy of Sciences (CAS) runs Changbai like a scientific boot camp, deploying an army of grad students and young researchers each summer. The ringlike ecological zones that change with altitude are a top draw. From the sky, the demarcation of forest types appears like a target, with the 2700-meter summit as the bull’s-eye. “It’s very unusual to have distinct ecological zones so easily observable in one area,” says Wang. Outside the reserve, he notes, one would have to hopscotch thousands of kilometers to see all the forest zones on display at Changbai.

Barnes and other U.S. ecologists have made scientific pilgrimages to Changbai. “I was very impressed with the beauty and diversity of the area,” says Mark Harmon of Oregon State University, Corvallis. “The buzz of the bees in the basswood trees was just amazing.” With CAS colleagues, Hank Shugart of the University of Virginia, Charlottesville, is using Changbaishan as a test bed for modeling vegetation response to climate change across Eurasia.

But scientific affection has not translated into robust protection. “Although no tree is allowed to be logged within the reserve, biodiversity has been degraded due to other human activities,” says Guofan Shao of Purdue University in West Lafayette, Indiana, who has mapped forest zones at Changbai. The most severe disturbances stem from the harvesting of two valuable commodities: ginseng roots and pine nuts. Wild ginseng is disappearing, so forest plots are cleared for



Bald spots. Logging and clear-cutting for crops have broadened the mountain’s bare patches, indicated in pink on this Landsat map.

ginseng plantations, causing erosion. And the removal of pine nuts impairs regeneration and forces animals such as the gray squirrel or the spotted nutcracker that feed on the nuts to find other food sources or die out. Local authorities, for the first time, have banned the collection of pine nuts in the reserve this year. As a result, says Shao, “they basically have to send people to guard the forest” during the summer months.



Reaching out. Wang Shaoxian hopes to work with North Korean scientists to restore Changbai’s embattled ecosystems.

Jilin authorities created JCMAS earlier this year to strengthen and coordinate research in the reserve. Although Changbai boasts a panoply of life, including more than 2000 plant species, “there has never been a systematic survey,” says Wang. Just such an initiative started last December and should be completed this autumn, he says. JCMAS plans to work with universities and CAS institutes to compile a DNA library of the reserve’s flora and fauna. And Barnes says a comparison of Changbaishan’s ecosystems with similar regions in Japan and eastern North America, “before further development renders them fragmented and domesticated, is of the highest international priority.”

Such work would undergird an ambitious attempt to “balance the competing interests of tourism and environmental protection,”

Wang says. Down the road, he says, saving Changbai may mean extending the reserve’s boundaries, which could require resettlement of villagers. Support for such a drastic measure might get a boost if UNESCO declares Changbai a World Heritage Site as expected in 2008, prompting a management and research policy vetted by international experts.

Chinese officials hope to kick off cooperation with North Korea in advance of World Heritage designation. “We’re very interested in working with them to restore the ecosystems,” says Wang. Since spring, he explains, the Chinese government has been providing “much more encouragement” for contacts with North Korean researchers. “The quality of their scientists is high,” says Dai, who in 2002 visited North Korea’s lakeshore research station, at the bottom of a zigzagging staircase hundreds of meters long that’s visible from the Chinese side. And exploratory talks have begun on involving U.S. researchers in projects with North Korea and China. Barnes, for one, is eager. North Korea’s forests “are one of the least well known to Western ecologists of any in the temperate zone,” he says.

Wang should be in a position to host collaborations in autumn 2007, when JCMAS expects to complete construction of a new research building. In the meantime, he and his colleagues are happy to see a treasure of two cultures finally getting the scientific attention it deserves.

—RICHARD STONE