

With a flick of its tongue and a slit-pupiled stare, a vine snake welcomes herpetologist Ted Papenfuss to Tam Dao, a species-rich national park in a country biologists have only begun to explore. Discoveries to date include 108 different snake species. "That's more than any other single site in the world," says the University of California, Berkeley, scientist. His team's mission: Catalog the park's animals—before they disappear.



Tam Dao

VIETNAM'S SANCTUARY
UNDER SIEGE

WEARING THE PANTY HOSE WAS Ted Papenfuss's idea. A prophylactic against leeches, said the University of California herpetologist and leader of our expedition into Tam Dao, one of Vietnam's newest national parks. And so there I was, clambering about in the steep, steamy jungles of the Tam Dao Mountains in queen-size, navy blue L'eggs. After a few hours of sweating it out (and with renewed respect for working women the world over), I dispensed with the panty hose in favor of the cotton leech leggings that our Russian colleagues favored.

It seemed a sensible trade-off. The start of the rainy season was late, it was terribly dry in the forest, and there weren't many leeches about. Besides, we were stalking snakes, in particular a 14-foot king cobra that Nikolai Orlov, a Russian herpetologist, had spotted before I'd arrived with the American team

for a month-long biodiversity study. If a cobra was to latch onto

my leg, a layer of navy blue nylon wasn't going to be of much use—except perhaps twisted and applied as a tourniquet.

Having never seen a cobra in the wild, I'd persuaded Orlov to take an hour of his time to try to locate it. If anyone might succeed, it was he. Since 1982, when Russian researchers began conducting surveys of Vietnam's long-closed jungles, they'd discovered some 30 species of reptiles and amphibians previously unknown to science; 17 of these were discovered at Tam Dao. Orlov and his colleagues have now expanded the count of snake species at Tam Dao to 108, or 4 percent of the global total of 2,700 species. By that measure the park harbors one of the richest, most diverse ecosystems on the entire planet.

The mix of species at Tam Dao exists partly because the park sits at an ecological crossroads. Animals from the tropical forests of Southeast Asia, the temperate forests of southern China, and the alpine forests of the eastern Himalaya all are represented. Moreover, the Tam Dao range rises so abruptly from the Red River Valley that its slopes are virtually an island in the sky surrounded by the floodplain below. This isolation produces a host of indigenous species, and gullies and ridges create more isolated spots where microhabitats form.

Papenfuss and a team of 15 field biologists from the U.S., Russia, and Vietnam had assembled to collect as many species of reptiles, amphibians, and mammals as they could in a month's time. Among the rarities they had already found were a curious little frog that resembles a lump of lichen and *Polypedates dennysi*, the world's largest gliding frog.

The team planned to compile a species inventory of Tam Dao's indigenous creatures, take tissue samples to determine their genetic makeup, and describe their anatomy and natural history. Ultimately the scientists hoped their work would contribute to a conservation plan for the park.

Starting at our research station below the resort village of Tam Dao, Orlov had led us up to what the team



Its fiery belly exposed, an endangered Tam Dao newt wriggles in the net of herpetologist Kelly Zamudio. The hills of Tam Dao harbor hundreds of endemic species—and host more and more people seeking to escape the busy streets of Hanoi, just 32 miles away (map).

called the Old French Road, which circles the heavily forested upper slopes of two peaks. Our sturdy little Russian four-wheel-drive whizzed past the bombed-out ruins of extravagant villas that French colonials had built early

in the century—and that bitter Vietnamese partisans destroyed in the mid-1950s after Vietminh forces overthrew French rule. Surprisingly, given the pounding that nearby Hanoi took during the later war with the U.S., Tam Dao showed no evidence of the bombing and defoliation that ravaged much of the rest of the country.

Orlov, a short, rotund, bearded dynamo from St. Petersburg's Zoological Institute, stopped our driver at a bridge spanning a stream and dismissed him for the night.

A halo of spines loaded with toxins awaits predators foolish enough to ignore a slug caterpillar's warning colors. A katydid (below, second from left) tries another tactic—blending into its grassy habitat. Innumerable animals stalk Tam Dao's insects, from bats and birds to tiger beetles (below), ants (attacking moth), and lightning-quick centipedes (far right). Beetles and butterflies face the toughest predators: villagers, who gather specimens to sell to foreign collectors.



SLUG CATERPILLAR, *SETORA FLETCHERI*



TIGER BEETLE, *COSMODELA AURULENTA*



KATYDID, *PSEUDOPHYLLINAE*



TIGER MOTH, *AMERILA ASTREUS*; ANTS, *LEPTOGENYS DIMINUTA*



CENTIPEDE, *SCUTIGERA* SP.

"We saw the cobra right down there, among the roots of that tree," Orlov said, aiming the intense beam of his flashlight toward a culvert beneath the bridge. "We observed it for a while and decided that there was no need to collect it." With so many lesser known reptiles at Tam Dao, a cobra was low on Orlov's wish list. He'd approached the slumbering female with caution, prodded her with a stick, and watched her slither off. Where she was lurking now was anyone's guess.

"Let's go down to have a look," said Orlov. When we reached the stream, he asked us to stay back some 30 feet. "Nikolai needs his concentration, and having more people along will disturb him and the snakes," explained Natalia Ananjeva, Orlov's wife, who heads the Zoological Institute's terrestrial vertebrates division.

The night sounds of Tam Dao filled the heavy air as we waited in the darkness—the

cheeping and croaking of frogs, the piercing metallic wail of katyids . . . and then Orlov, calling for us to join him. When we did, he was gripping a venomous, writhing, four-foot, black-and-white banded krait just behind its head. He lowered it carefully into a cotton sack, which he knotted and stuffed into his rucksack.

ON THE LIST of Earth's deadliest snakes, kraits rank right up there with cobras. Seeing this one put me in mind of Sergei Ryabov, who was searching for the cobra upstream from the bridge culvert. His right hand was missing a finger. Working late at a reptile zoo south of Moscow one night several years ago, Ryabov had reached into a terrarium containing a highly venomous Gaboon viper. He thought the viper was out of striking range. It was not.

"The snake jumped so fast," said Ryabov. "It was my fifth bite from a venomous snake, and I had an intuition that this one was serious. I was lucky that it bit only my finger. I summoned a security guard, and in 50 seconds he arrived with an ax and the finger was off."

Oregon-based writer MICHAEL MCRAE rafted a wilderness river in Uzbekistan for his last GEOGRAPHIC assignment (November 1997). Ecologist MARK W. MOFFETT began working in tropical forests at age 17. He has contributed to the GEOGRAPHIC since 1986.



Ryabov had explained that herpetologists seldom have antivenin available on short notice, especially in the wild, because each venom type requires a specific antivenin. Plus, the risk of botched administration or severe allergic reaction to the antivenin makes it, in some cases, as dangerous as the snakebite itself.

Orlov, at any rate, seemed unconcerned, and with our krait safely bagged, he was off again. Several minutes passed before he summoned us once more. "Look down," he said, aiming his flashlight at my feet. "Can you see it?"

"See what?" I asked.

He reached down and came up with another krait, as long as the first but more agitated. As the snake went into the collecting sack, I realized just how acute Orlov's vision was. He'd spotted the krait even though it had been concealed except for one tiny patch of skin. I'd heard about Orlov finding a tiny moss frog two years ago in a cistern of a ruined villa. The only way he'd distinguished it from its mossy surroundings was by its eyeshine—the reflection of his flashlight in the little frog's eyes.

Back at the bridge culvert we searched again for the cobra's lair, but all we found was candy wrappers and soda cans where the snake had been. In the distance below us, a chorus of caterwauling poured from the village's karaoke bars—weekend tourists from Hanoi. With alpine relief just two hours by bus from the sweat and pandemonium of the city, it's no surprise that the village's guesthouses and hotels are packed every weekend during the tourist season.

Orlov sat on a rock shaking his head.

"Look at this trash!" he boomed. "Two weeks ago, none was here. That house? It was not here ten years ago. All of this was primary forest. Every morning I saw monkeys here. Yes, right here! Now every month we see a new building."

But his mood was fleeting. Orlov bade us farewell and during the night collected a legless amphibian called a caecilian, a number of gliding frogs, and three snakes, including a rare species long considered a member of the genus *Boiga* but that Orlov believes represents an entirely new genus. It was as if the specimens had fallen from the trees directly into his sack.

Standing on the porch of the field station next morning at sunup, Orlov was his old irrepressible self. When I asked to see his finds, he pulled prize after prize out of his sacks.



Each morning locals offer animals to Russian herpetologist Nikolai Orlov, who pays a few dollars for desirable specimens. "If we don't buy them, they'll be eaten," he says—or, in the odd case of squirrels mounted for sale at souvenir stands, the first sight tourists see as they arrive in Tam Dao village (facing page).

With each one he took half a step back, cocked his right foot out in the manner of a Roman orator, held the specimen at arm's length, and announced its scientific name in Latin.

Researchers hope that their work will someday put Vietnam on the map as a mecca for natural history tourism and that the income can be channeled into conservation. But right now locals, who have few prospects for employment, make the most of the tourist season in other ways. They sell the insects, butterflies, and snakes they collect as souvenirs. One beetle may be worth a hundred dollars to Japanese or German collectors. The trade is illegal, but if violators are caught by police,



Twitchy menagerie: Marjorie Matocq inspects a haul of live salamanders and lizards collected by the team at their temporary headquarters, a research station set up a decade before the first postwar visit by an American scientist, in 1994.

they generally end up just paying a small fine.

Restaurants also serve the meat of the small mammals that the locals trap and don't eat themselves. Snakes and turtles are so widely eaten that some species are seriously threatened. And illegal cutting of tropical hardwoods and bamboo from the forests on the upper slopes of the Tam Dao Mountains is a constant threat.

HERPETOLOGISTS WORK in darkness, when nocturnal creatures move about in search of food or mates. Tracking them, I was learning, requires not only a powerful light but also a great deal of stamina. I found myself one night with Oleg Shumakov from the Moscow Zoo, searching for snakes and frogs near a spot where Orlov had first found a venomous, white-headed Fea's viper, so rare that fewer than a dozen exist in captivity. The temperature at 11 p.m. was 85 degrees, the humidity 80 percent. We clambered up a streambed and slithered over slick rocks. A thousand tiny lights winked back at us as the beams from our headlamps caught the eyes of frogs and spiders, dewdrops, and iridescent beetles.

The collecting did not go well for us that night, due to the dry season, we concluded. Others reported similar results. Indeed, Orlov was the only team member who was consistently successful. He had announced that his night's goal was to find a male *Boiga*, his suspected new genus, and he scored. Orlov's achievements were not unexpected though. By now I knew him to be a scientist with an impressive grasp of the natural history of the species he stalked. The 45-year-old Russian's career total of collected specimens numbers in excess of 60,000. Papenfuss, who has been collecting for many more years than Orlov, puts his count at a respectable 24,000.

And so, in spite of the unseasonable drought, our collection grew rapidly. Orlov's room resembled a cross between a biological laboratory and a Laundromat. Beneath lines of drying socks and trousers stood stacks of plastic terrariums. Opening their lids, Orlov showed off squirming masses of green tree vipers, lizards with flaps of silky orange skin on their abdomens that allow them to glide from tree to tree, snakes that eat slugs and worms, others that eat all kinds of lizards, still others that eat only skinks and geckos.

Among the other curiosities in the team's collection were little blind snakes that looked like earthworms, legless lizards, frogs that resembled lumps of tree bark, and perhaps the most perfect example of protective mimicry: a harmless rat snake with brilliant green skin and a white stripe—just like that of a venomous green tree viper.

But as fascinating as these adaptations were, few of the creatures could match the web-toed gliding frogs. The six-inch-long amphibians can spread their legs, splay out their toes, and parachute to the ground from great heights. Not only are there gliding frogs in Tam Dao, but also gliding snakes, squirrels, geckos, and other lizards.

One theory about why so many aerobic species have evolved in Asian forests is that trees here are generally taller than those in, say, Africa, and are not as well linked by woody vines called lianas. Webbed toes and gliding flaps would afford a distinct advantage by providing a way to "fly" from tree to tree.

But can human changes to the forest environment cause species to adapt? It's a question that intrigues Kelly Zamudio, the team's DNA specialist. To hunt for answers, she was collecting *Polypedates leucomystax*, a non-gliding relative of the big tree frogs. To my untrained eye they all looked identical, but as Zamudio explained, those living in clearings around Tam Dao's reservoir had smaller toe pads than those inhabiting the undisturbed forests high in the mountains. It was her aim to discover through DNA analysis if the variation in toe shapes resulted from genetic differences or simply from different living conditions.

The taxonomy of Asian tree frogs might seem arcane to the layperson, or even irrelevant. But in applying modern genetic tools to solve issues of scientific classification, researchers like Zamudio are answering basic questions about evolutionary biology that Charles Darwin and Alfred Russel Wallace were puzzling over more than a century ago—how species arise, for example. If her tree frogs are indeed genetically distinct, Zamudio said with excitement, "it could show the beginning of the process of speciation."

Today's genetic tools also can help scientists make difficult conservation choices. If a lineage contains five species, all endangered, but resources are available to save just two, which



Skinned and gutted alive, a snake writhes in a Hanoi restaurant ("snake specialties" boasts its business card). The animal's blood, heart, and genitals, at right, are said to confer virility, a promise that fuels the annual export of millions of live snakes. Park rangers release a brush-tailed porcupine at a ceremony symbolizing Vietnam's struggle to curb the animal trade.



"A face like Jabba the Hutt's," says Ted Papenfuss of the moss frog. Nikolai Orlov found several of the tennis-ball-size animals in the cistern of a demolished French colonial villa. The frogs look so much like wet moss that few can spot them. Other amphibians and reptiles (below) are camouflaged to hide in bamboo, trees, or leaf litter on the rain forest floor. At least 17 new reptile and amphibian species have been discovered at Tam Dao since 1982.



MOSS FROG, *THELEDERMA CORTICALE*



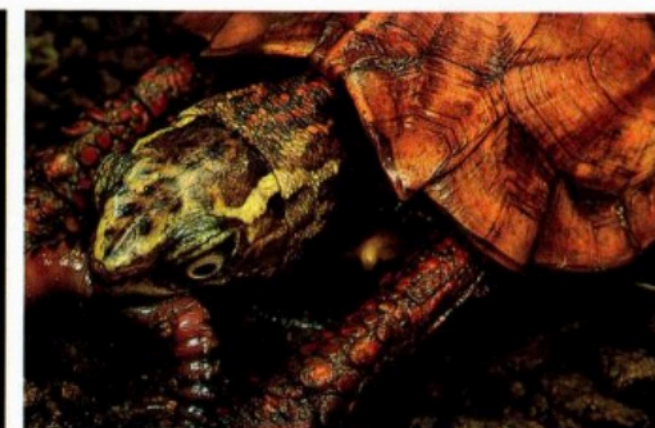
BAMBOO SNAKE, *PSEUDOXENODON BAMBUSICOLA*



ASIAN PAINTED FROG, *MICROHYLA PULCHRA*



WATER DRAGON, *PHYSIGNATHUS COCINCINUS*



BLACK-BREASTED LEAF TURTLE, *GEOEMYDA SPENGLERI*



Weekenders crowd a pool at the park's edge, where income from tourism and hunting helps sustain local residents. Sharing their home with a stuffed deer, schoolgirls Vu Hong Nhung and Hang Thi Thu (below, at left) buy books with cash they earn selling beetles. Vietnam's challenge: Protect the park's animals without harming the lives of people in its shadow.



two should they be? Twenty years ago biologists might have selected the scarcest two. Now they might choose the two that are farthest apart in terms of their genetic codes. Likewise, phylogenetic studies can show which of two imperiled ecosystems contains the greater number of unique species and is more urgently in need of protection.

Reaching this level of knowledge about the forests of Southeast Asia is probably 50 years away. Meanwhile, karaoke bars and guesthouses flourish at Tam Dao, and most of the hard-pressed villagers who live nearby still try to make a living from the forest however they can. Unlike the locals, scientists are allowed to collect species samples from the park. So the purchase of specimens by scientists from locals, while considered unethical by some, is generally accepted in the name of scientific research, especially when field time is limited. As I sipped my coffee each morning in a small garden near the field station, I could hear Orlov haggling with hunters of all ages. They began arriving around 7:30 proffering bats, rats, vipers, lizards, and all manner of beetles.

"Why have you brought this to me?" Orlov would ask as if offended. "It is very common; we have many already." Some specimens he bought; those he rejected were offered to me. There was no escaping this commerce. Everywhere we went, we were accosted by children with pockets full of beetles. "Mista, you buy!" they would say.

PLAYING DEVIL'S ADVOCATE one morning, I asked Jim Patton, an evolutionary biologist from Berkeley, what good our survey was doing and why it was important to preserve biodiversity in the first place. "It's a legitimate question that we can't always answer," he said as he deftly stripped the skin off a rat and stuffed the skin with cotton. "The classic answer is that in cutting down a forest we may lose a cancer drug we never knew existed. But I don't think that's valid. We should be trying to educate people that they're part of the whole, rather than in control of the whole. It's important to show where people came from and how they fit in.

"Life is a web, and if you remove pieces of the web, it crumbles—in what ways, we can't always predict. There are certain organisms

that most people agree we should preserve: pandas and tigers, for example. But they're only part of the matrix. They depend on these rats and beetles. There's a certain amount of redundancy in the pyramid of interaction. But how much? That's the crux. Preserving a place as richly diverse as Tam Dao can help us find the answers."

Developing a conservation plan for Tam Dao is high priority for Cao Van Sung, the energetic director of Vietnam's Institute of Ecology and Biological Resources in Hanoi. With data supplied by several different research teams about the age structure of species populations as well as their reproductive biology, diet, and growth rates, Sung already has some of the basic biological information necessary to manage the park's ecological future. But Patton thinks Sung's work has another, perhaps more important, purpose.

"What we're doing on this sort of expedition is relatively trivial," says Patton. "A month of surveying is nothing. But the value to Vietnam is in developing international relations that can sustain a dialogue. Information can be transferred, students can be brought to universities in other countries. That's what Sung is doing—he's making connections."

A guidebook I'd brought along said that the mist and clouds sometimes blow through the windows of the hotels in Tam Dao. On my final morning this proved to be true. The hot, dry weather had taken a turn. Great swirls of mist curled down from the north, pouring through the windows of our pink stucco guesthouse and cascading over Tam Dao's denuded lower slopes. The rains would soon come. The Old French Road would be squirming with creatures that had been holed up in the damp streambeds trying to stay cool and moist during the drought. There would be an orgy of mating and predation—a rearranging of the web of life of which we humans are a part.

At last the rains arrived and the team's success at collecting took a sudden turn for the better. But they would never relocate that cobra Orlov had spotted and I had hoped to glimpse. Still, it had been heartening to see 15 scientists from three nations—nations previously at odds—working together to ensure the survival of king cobras and thousands of other creatures, each one a marvel of evolution and adaptation. □