E. DALZIEL/AP

YEAR OF THE TIGER

Dubious science and looming legalization of the tiger trade threaten to derail China's efforts to save the Siberian tiger. **Jerry Guo** goes to the world's largest tiger-breeding facility to investigate.

The automated gates chug and clatter open as a jeep, its windows ribbed with steel, noisily announces its arrival in the tiger park. Without the usual gaggle of tourists to impress, the occupants of a neighbouring jeep toss out a skinny pheasant as the driver shouts obscenities at a dozen lounging Siberian tigers. For sightseers they would have released a bull, but they cost US$250 each.

One tiger finally takes notice and lunges at the fluttering fowl, which has enough brains to scuttle under one of the jeeps. The tiger, neither as sharp nor as small as the pheasant, slams into the vehicle with a thud. And as the hulking beast shakes off the dust and disappointment of his failed attempt, the pheasant dashes into the brush. The striped leviathan promptly settles back down, seemingly deciding that the prey isn't worth the effort.

And why not, for these tigers are already well-fed, particularly by the 300,000 tourists who flock every year to the tiger park at the Hengdaohezi Feline Breeding Centre on the outskirts of Harbin in northeastern China's Heilongjiang province. By most accounts, the place is an enviable success. Started in 1986 with 8 Siberian tigers, it is now home to 800 of the big cats. Compare that with the estimated 150 Siberian tigers in US zoos. The largest tiger-breeding facility in the world, Hengdaohezi — like its cousin down south at the Wolong Panda Reserve — has learned the art of churning out cubs, 100 this year alone.

But this year the centre has been subject to all sorts of media attention, from gruesome videos on the Internet of tigers eviscerating a bull as tourists gape, to reports of plans to reintroduce 600 of the cattle-fed, people-friendly tigers into the wild. At the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) meeting this June in The Hague, the Netherlands, China's tiger-breeding programme was criticized for at best creating tourist traps, and at worst being flat-out farms for the animals. Indeed the Hengdaohezi facility was developed as a government-run enterprise to capitalize on the tiger-bone trade. Since the practice was outlawed in 1993, the park has depended on tourism for 80% of its $4 million per year operating costs. But shortly after the CITES meeting, Wang Wei, a deputy director at the State Forestry Administration in Beijing threatened the imminent reopening of the tiger trade, inviting 70 international tiger experts to Hengdaohezi in July to hear the merits of such a move (see 'Another pickle for Siberian tigers').

So far, Western scientists are unconvinced that the proceeds from farming the animals might fund conservation efforts. Moreover they doubt whether conservation is something the facility is interested in or even equipped to do. "They want to use their bones and parts," argues Sybille Klenzendorf, who toured the facility in 2006 as director of species conservation for the conservation group WWF. "It's basically a tiger farm operating under the pretence of a research facility."

> "It's basically a tiger farm operating under the pretence of a research facility."
> — Sybille Klenzendorf

In a concrete bunker off-limits to gawking tourists, mother tigers nurse their cubs in tiny cages. The park's chief scientist, Liu Dan, proudly surveys his charges. For him, the objective is straightforward. "Our goal is to reintroduce them into the wild," he says. He denies media reports of an earlier failed reintroduction. The centre did, however, send ten tigers to a small area resembling alpine forest in the Changbaishan reserve, close to the North Korean border. "It's a very good wild habitat. A good exercise in all aspects of training, but still a big difference to the wild," says Liu Dan.

Genetic sleuths

The park contains roughly twice the number of Siberian tigers that exist in the wild, and letting loose even a few captives would have widespread conservation implications — especially in the small remaining natural range in northeastern China where perhaps ten tigers reside. But reintroduction wouldn't be just about bolstering the wild population.

In 2004, Michael Russello and his colleagues at Yale University in New Haven, Connecticut, published a study in *Conservation Genetics* indicating that all but 2 of the roughly 60 wild Siberian tigers they sampled shared a single

mitochondrial haplotype[1] — a set of genes that is inherited en masse. "The genetic diversity was about as low as it gets," Russello says. In particular, his data suggested that captive tigers, at least those in North America, may be more genetically diverse than their wild counterparts. But he doesn't know if this corollary holds true for Hengdaohezi's 800 tigers. If so, "they could re-inject variation that has been lost in the wild".

At Wolong Panda Reserve, keepers are increasing the population to maintain a healthy genetic reservoir in case of a sharp drop or extinction in the wild. Three hundred pandas is apparently the magic number, and tourists are no less impressed. There, as in Hengdaohezi, even keeping the animals caged can benefit conservation, as long as pedigrees are tracked and specific pairs matched to maximize diversity, says Shujin Luo, a conservation biologist at the National Cancer Institute in Frederick, Maryland. That's not the case at Hengdaohezi. Although Luo is currently analysing the genetic diversity of wild versus captive Siberian tigers, like Russello and other Western researchers, she has not been able to obtain any samples from Hengdaohezi.

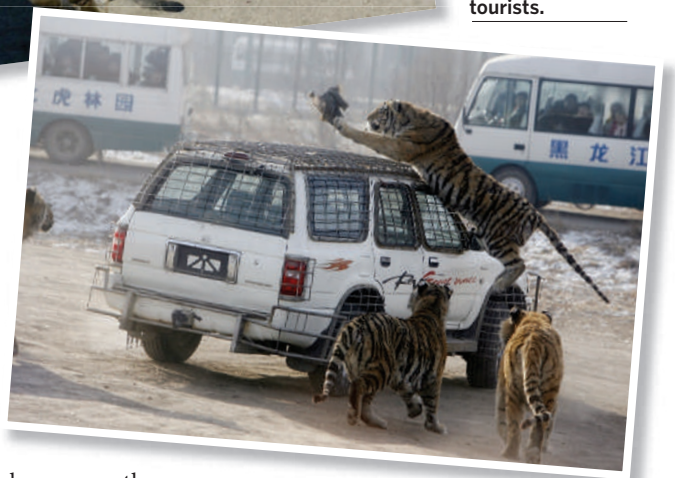
One person who has obtained samples says he is confident in the diversity of the Hengdaohezi stock. Across town from the facility, forensic geneticist Xu Yanchun of Northeast Forestry University in Harbin, has collected 500 blood samples from the place and plans to have a completed 'genebank' of the captive population by this winter. "I'm sure genetic diversity here is higher than in the wild," he argues, citing indicators such as heterozygosity and allelic distribution from his unpublished data. "This population is quite high in genetic diversity because they are well managed," Xu says.

Fuzzy breeding

The tourists love the liger enclosure — they can't snap enough pictures as the tour bus slowly rolls past lions, tigers and their enormous hybrid offspring, all basking next to each other. The huge animals, a cross between a male lion and a female tiger, are a dramatic sight, but such disregard for intermixing could lead to bigger problems. The property also contains Bengal tigers, technically a different subspecies from their Siberian cohabitants, and the subspecies could produce harder-to-spot hybrids together.

In general, Hengdaohezi's breeding strategy is crude compared with Western practices. Unlike US and European zoos that use computer models to calculate exactly which animals should mate together — and stud books to track every individual at Hengdaohezi, Xu's genetic pedigrees are mostly ignored. Liu Dan concedes that the centre doesn't control or record which tigers breed together (as long as they're not brother and sister). "We don't have the resources," he says.

CHINA DAILY/REUTERS



T. O'ROURKE/SINOPIX/REX FEATURES

Killer moves: tigers in the Hengdaohezi park learn to hunt by killing livestock, in what is often a display for tourists.

"Now they're all breeding haphazardly," says Liu Yutang, a cryogeneticist at Northeast Forestry University. "We have to wait until our technology is better so that we can control which tigers will mate." In captivity each female may mate with several male tigers when sexually receptive, confusing keepers on the paternity of the resulting cubs. The centre also rarely exchanges tigers with other breeding facilities. US zoos regularly shuttle tigers across the country to breed, explains Kathy Traylor-Holzer, the Siberian tiger stud-book keeper for American zoos. "The fear is to accept an animal from Harbin as they may carry genes from other subspecies," she says. "If you don't manage the population, you automatically lose genetic diversity."

The breeding facility is not a member of the international stud book for Siberian tigers, which includes almost all US and European zoos. "It's because they breed the same animals over and over again, which you would never do as a registered stud-book zoo," says Klenzendorf. Xu, who serves as a breeding consultant to Hengdaohezi, refuses to use the international stud book's standard software program, SPARKS, which calculates the degree of inbreeding for each individual. "The prediction is not accurate," he says, citing more unpublished data that indicate that sperm genetically similar to the female's genotype stand less of a chance in the oviduct, a case of 'selective fertilization'. "This model has the precondition that all alleles are passed on randomly, which is not accurate because of my selectivity theory," says Xu.

But Xu's claims about the population's high genetic diversity draw doubts even from colleagues such as Liu Yutang who says physiological problems from inbreeding already run rampant. "Some tigers are very weak, have different stripes, high cub mortality rates, and reduced immune systems," he says. "And when they're all related, then it's easier for something to wipe them all out," he adds, citing the waves of deaths from bird flu and canine parvovirus. Liu Dan says he's not aware of these tiger deaths, but Xu says they numbered in the "several tens" in 2005.

Luo says she reviewed one of Xu's papers on the genetic fitness of Hengdaohezi tigers and didn't consider it good enough for publication. "Every few months we receive papers from China about tigers; overall the quality is disappointing," she says. So far, Xu's data from the past decade at Hengdaohezi have not been published in a Western journal, although he did publish a paper in *Forensic Science International* detailing a genetic fingerprinting method to combat Siberian tiger poaching[2].

Siberian sperm bank

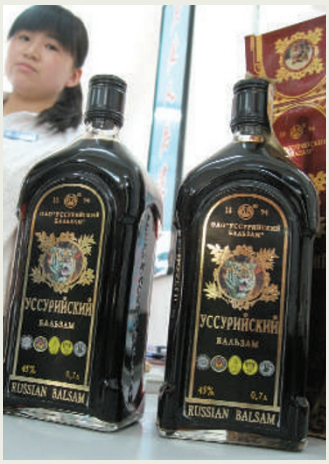
In his university office, Liu Yutang grabs a giant syringe equipped with a video camera and a light. To help bring the centre to Western standards by controlling exactly which tigers mate, he has developed this gadget for artificially inseminating the females. He tried it earlier this year with no luck. Still it was an

Another pickle for Siberian tigers

On a nondescript street near downtown Harbin, the Double Mountain Local Products Wholesale Centre offers the usual array of kitsch items stripped from the wilderness: deer antlers, pelts and dried starfish. A request for tiger wine, a traditional brew of corpse-steeped cheap liquor with dozens of reputed medical benefits, raises a stern eyebrow from an employee who informs a customer that as such concoctions are illegal, they are not available at the store. But at the mention of American money, a store manager intervenes — $100 would buy two bottles, and true to the employee's words they are not at the store; they will be delivered via courier. Doubts about the brew's authenticity are shooed away. The manager is certain the bottles are the genuine article because, she says, "they came from over at that tiger park". She is referring to the Hengdaohezi Feline Breeding Centre on the outskirts of the city. And whether or not she is speaking the truth, the manager is highlighting a looming international stand-off between conservationists and the Chinese government.

China banned domestic trade of tiger parts in 1993, but that did not arrest the desire for their use in wine or traditional Chinese medicine. A black market fills the demand and goods can often be traced back to breeding centres. In August 2006, a tiger farm in Guangxi province was caught with 400 vats of wine, each stewing a whole tiger carcass. This June at the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) conference in The Hague, the Netherlands, wildlife officials used DNA evidence to accuse the same farm of serving tiger meat.

In a walk-in fridge at Hengdaohezi — off-limits to tourists and journalists — 200 frozen tiger carcasses lie scattered, waiting to be turned into tiger wine and medicine, according to Xu Yanchun, a breeding consultant for the park at neighbouring Northeast Forestry University. Whether Hengdaohezi benefits tiger conservation is questionable, but one thing is certain — if the government lifts the ban on the tiger trade, places such as Hengdaohezi will profit.



C. JENNINGS

Dark liquor: is it tiger wine?

Liu Dan, the park's chief scientist, doesn't see a problem. "We can use dead tigers to save live tigers," he explains, promising to use profits for the centre's genetic and reintroduction projects. And the government seems to agree. "It's very hard to go against these pressures to open the trade," says Wang Weisheng, manager of wildlife resources at the State Forestry Administration.

Wang says a decision on the ban could be made as early as October. As of 2006, all tigers have been required to wear a microchip, and Wang says such tracking abilities combined with a certification process — a system that met with success with China's ivory, crocodile and ginseng trade — could lead to a win–win situation for everybody. But lifting the ban may be illegal. Craig Hoover, chief US CITES enforcement officer, says China would be flaunting an existing international ban on tiger parts — and noncompliance could lead to sanctions.

Although several Western economists suggest harvesting captive tigers would relieve poaching pressures, and ultimately funnel money to conservation efforts, most conservationists disagree. "You can't possibly saturate the market with just parts from tiger farms," says John Goodrich, a conservationist with the Wildlife Conservation Society, New York. "It'll be devastating for wild tigers." **J.G.**

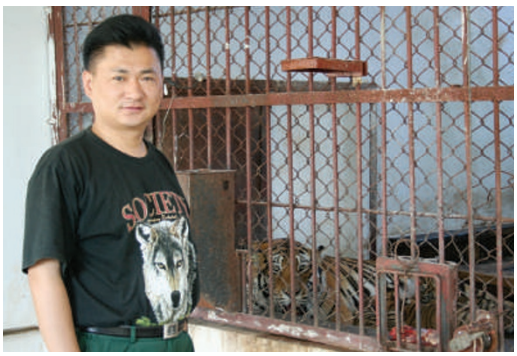
improvement on the prototype, which, he says with a grimace, was "too sharp".

Liu Yutang says he is attempting to assemble a Siberian tiger sperm bank with samples from the entire Hengdaohezi population for artificial insemination. He's even eyeing wild tigers as possible targets for collection, but there's still a lot to learn. He admits his team doesn't yet know all of the basics, such as when tigers produce sperm. "A lot of this work is through trial and error," he says. For example, 8 of 23 semen samples he has extracted so far from the captive tigers yielded no sperm.

Liu Dan's plans to reintroduce tigers into the wild have faced further criticism. "They'll wreak havoc in the villages after being fed chickens and getting used to jumping on cars," says John Goodrich, a conservationist with the Wildlife Conservation Society in New York. "And there's absolutely no need to release tigers at all when tigers from Russia will move into China."

For now, the Siberian tiger's foothold seems sturdier than that of its cousin, the South China tiger. As a result of poor breeding and poaching, the South China population now numbers 66, all caged in a handful of zoos. Xu says the existing population is extremely inbred, with high mortality and low fertility. A paper under review at *Current Biology* paints an even bleaker picture. Yue Bisong of Sichuan University in Chengdu, notes that of 45 tigers he sampled, only 13 were pure South China tigers, the rest were hybrids with other tiger subspecies.

With its baffling breeding techniques and plans to open a market in tiger parts, Hengdaohezi hardly seems the safest place for Siberian tigers, but how they would fare in the wild is even more uncertain. So perhaps it is fortunate that the reintroduction campaign is mainly hype for now. Although media reports mention plans to release 600 of the captive tigers (apparently hoping to coincide it with the Beijing Olympics), the centre has not yet separated any group for eventual reintroduction, selected any potential release sites, or built specialist training enclosures. As Liu Dan broods over his nursing mothers, he defends the conservation work of the centre, posing the rhetorical question that if they weren't keeping the tigers around for a greater purpose, wouldn't they be just another tiger farm? "From breeding to reintroduction is a long process," Liu Dan says. "The programme isn't mature yet." ■



C. JENNINGS

King of the jungle: Liu Dan oversees 800 Siberian tigers.

Jerry Guo is a freelance writer in New Haven, Connecticut, reporting from China.

1. Russello, M., Gladyshev, E., Miquelle, D. & Caccone, A. *Conserv. Gen.* **5,** 707–713 (2004).
2. Xu, Y. C. *et al. Foren. Sci. Int.* **151,** 45–51 (2005).

See Editorial, page 2.