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The Once and Future Tiger

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Central Asia's "extinct" Caspian tiger and Russia's Amur (Siberian) tiger have a past—and perhaps a future—in common.

In reeds tinged red by the Central Asian sun, a tiger once roamed. There, in riparian forests that line rivers like the Vakhsh on the border of the former Soviet country Tajikistan, the Caspian tiger (*Panthera tigris virgata*) prowled.

Until its extinction in the mid-1900s, the tiger stalked Bukhara deer along *tugai,* thicketed watercourses that flow through Central Asia's otherwise vast, arid deserts. The tiger's route took it across shaded rivers and onto muddy banks. Peering into shoreline bracken, the tiger crawled through a latticework of tangled low shrubs, finally emerging into the willow and poplar forests favored by its deer prey.

And into trouble.

In the early 20th century, the Russian government instructed its army to exterminate all tigers as part of an agricultural conversion project across Central Asia. Once Caspian tigers were almost gone, farmers moved in, clearing tugai and planting crops such as cotton. The tigers retreated, first from lowland streams to marshes around larger rivers. Finally, they crept into forested mountain ranges.

The Caspian tiger's last stronghold was a reserve in Tajikistan: *Tigrovaya Balka*, "tiger former river channel." The name was given to this first of Central Asia's protected areas, or *zapovedniks*, in 1938 after a tiger attacked two Russian Army officers riding horseback along a dried-up river channel, or *balka.*

Lyuti is an adult male Amur tiger that was wild-born but orphaned as a cub and brought to the Utyos Wildlife Rehabilitation Center near Khabarovsk, Russia. The center has rehabilitated tigers that were then released back into the wild with the help of the Wildlife Conservation Society and Russia's Inspection Tiger. Photograph: John Goodrich, Wildlife Conservation Society.

In 1947, Russia banned hunting of the Caspian tiger's close relative, the Siberian, or more properly Amur, tiger (*Panthera tigris altaica*), still found today near the Amur River in the Russian Far East. But the edict came too late for the Caspian tiger, says Carlos Driscoll, a biologist at the US National Cancer Institute's Laboratory of Genomic Diversity in Frederick, Maryland. The last tiger in Tigrovaya Balka was glimpsed in 1958. Although still a matter of debate, the legendary final wild Caspian tiger may have been killed in February 1970, in Hakkari Province, Turkey.

New DNA evidence, however, reveals that we may not have seen the last of this tugai tiger.

Badly needed good news

In the past century, the number of tigers worldwide plummeted from more than 100,000 to little more than 3000. Tigers were once found in forests and other dense vegetation throughout Asia, from the Caucasus Mountains and the Caspian Sea to Siberia and Indonesia. Today the range of the tiger is a mere 7 percent of what it once was. In the last decade alone, the estimated area occupied by tigers has declined by 41 percent.

Of nine tiger subspecies, five still remain: the Bengal, Indochinese, Malayan, Sumatran, and Amur tigers. The Caspian, Javan, Bali, and

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perhaps South China tigers have gone extinct. "They're among conservation's most poignant morality tales of loss," says Driscoll, who aims to make a difference for at least one tiger subspecies.

In 2010, the Chinese Year of the Tiger, Driscoll and others are working to bring back the Caspian tiger. The outcome lies in a tale of two tigers that are in fact one; a tale of two ecosystems, the tugai of Central Asia and the taiga of the Russian Far East; and ultimately a tale of *Panthera tigris* and *Homo sapiens*.

The story takes shape in Driscoll's childhood. "I remember the tigers being declared extinct and thought it was so wrong that this could have happened," he says. Decades later, he wanted to resolve questions about the taxonomy and biogeography of the tigers, long-standing unknowns. Why not look at the mitochondrial DNA (mtDNA) from museum specimens? (Mitochondrial DNA is the tool often used in evolutionary studies, in part because it evolves several times faster than nuclear protein-coding loci.) The Institute of Zoology in Almaty, Kazakhstan; the Medical College in Baku, Azerbaijan; and the Zoological Museums of the Russian Academy of Sciences in Moscow, Novosibirsk, and St. Petersburg all house specimens of Caspian tigers collected long ago. Researchers at the museums were "happy to see work done on animals that were painstakingly collected and often underappreciated," Driscoll says.

He and his colleagues analyzed mtDNA in samples from these preserved tigers. Except for one Caspian tiger housed in the Moscow Zoo but originally taken from the wild in Iran, the 20 specimens studied came directly from places such as the banks of the Ili River in Kazakhstan and the Piandji River in Tajikistan. The samples are from 15 generations of wild tigers in China, Kazakhstan, Afghanistan, and Uzbekistan that were brought into the museums between 1877 and 1951.

The scientists compared the Caspian tiger samples with all other existing tiger subspecies in a phylogeny that includes leopards and clouded leopards. Using mtDNA analysis, they found that Caspian and Amur tigers have almost identical genetic sequences, differing by only a single nucleotide. "The tigers are too closely related to be separate subspecies," Driscoll says. "Caspian and Amur tigers are one."

In the era before molecular taxonomy, tiger subspecies definitions were based on classical criteria: geographic origin, size, and pelage (fur) variation (hair length, color, stripe number, and patterning). Given the new genetic data, Driscoll believes, pronouncing the Caspian tiger extinct may have been premature.

Amur and Caspian tigers share a haplotype, a set of closely linked genetic markers on one chromosome, derived from the main Caspian haplotype—not the other way around. The results were a surprise to scientists who thought Caspian tigers were descended from Amur tigers.

The discovery sheds light on how the tigers made their way across the fabled lands of Central Asia. "Several routes had been proposed by which Caspian tigers might have colonized their historic Central Asian range," Driscoll says. They include a southern route through the Indian subcontinent south of the Himalayan plateau; a northern route, with tigers settling first in the Amur River region and then traversing Siberia westward north of the Mongolian steppe; and a middle route through the Gansu corridor between the Himalayan plateau and the Mongolian Gobi Desert.

If colonization had occurred through the Indian subcontinent, a close molecular link would exist between Caspian tigers and Bengal tigers—one not found in Driscoll's research. A northern migration route from south China north to Siberia and then west is also unlikely; this route would have produced genetic similarities between Caspian tigers and South China tigers, but they weren't there, either.

Phylogenetic inference and the historical geographic range of tigers suggest that some 10,000 years ago, Caspian tigers took the middle route. They used a lone trail, one that was to become the Silk Road, to migrate from eastern China to the region around the Caspian Sea. "The tigers paved the way for the Silk Road," Driscoll says, "between the Himalayan plateau and the Mongolian Gobi Desert."

The corridor they used—a narrow funnel not much wider than the dusty, caravan-traveled Silk Road itself—was bordered on one side by mountains, on the other by desert. From there the tigers entered Central Asia. Eventually some returned eastward across southern Siberia, establishing the Russian Far East's Amur tiger population. But increasing human presence in the region within the last 200 years very likely stopped tigers from traversing this crossroads.

The new findings raise the possibility of repopulating a now tigerless Central Asia with Amur tigers, according to tiger biologist Ron Tilson, director of conservation at the Minnesota Zoo in Minneapolis and coeditor of *Tigers of the World: The Science, Politics and Conservation of* Panthera tigris (Academic Press, 2010). "In the right habitat," Tilson says, "the Caspian tiger's former range is open to reintroduction with Amur tigers."

No tigers without tugai

Rivers that cut through the steppes and deserts of Central Asia bring life in the form of tugai to these dry lands. "They allow the tugai to flourish," says Olga Pereladova, director of the World Wildlife Fund (WWF) Central Asia Program, "and with it, tigers. Tugai is an oasis for resident and migratory wildlife."

Tugai spans a transition from river to sand, mud banks to shoreline reeds, fringing shrubs to tangled forests, and ultimately to desert—then mountains. Stretching in green, snakelike bands through Central Asia, tugai was once widespread. Now it remains only as fragments along rivers such as the Ili in Kazakhstan and Amu Darya in Uzbekistan. Other extensive tugai still exists in and around Tigrovaya Balka and along Kazakhstan's Syr Darya River.

Tigrovaya Balka Nature Reserve is located in Tajikistan close to the Afghan border, where the Vakhsh River (pictured here) flows. Although the Caspian tiger for which the reserve is named is gone, Tigrovaya Balka is still home to the tiger's main prey, the Bukhara deer. Photograph: Olga Pereladova, WWF.

Wherever tugai thrives, it's composed of a gallery of impenetrable thickets entwined with lianas, dotted by patches of grassy clearings, and interspersed with wetlands. Poplar, willow, and tamarisk trees alternate with meadows and reeds. Briar roses and honeysuckles twist through the understory. "If you were flying over tugai," Pereladova says, "you'd see willow and poplar forests almost indistinguishable from meadows and swamps."

Several Central Asian reserves, including Tigrovaya Balka, have been established to protect tugai remnants. "But their size and management is insufficient for long-term success," Pereladova says. The main problem, she believes, is a limited supply of water; dams still funnel it to agricultural fields.

Among the most important tugai residents is the Bukhara deer, a species endemic to Central Asia. By the end of the 1980s, the deer numbered no more than 900 in the wild. In response, WWF started a Bukhara deer restoration project. Bukhara deer were translocated to tugai in the southern Turkestan district in Kazakhstan in 2009. Two years before, the deer were released in Uzbekistan's Zarafshan Nature Reserve, and in Kazakhstan's Altyn-Emel National Park on the banks of the Ili River. The deer are reproducing well, Pereladova says. For a successful reintroduction of tigers into the tugai ecosystem, they must. Bukhara deer once sustained Central Asia's Caspian tiger population—and will have to again.

Last year, WWF-Russia and WWF-Netherlands undertook a feasibility study for Caspian (Amur) tiger reintroduction in Central Asia. The results identified at least two likely habitats: the Amu Darya Delta and the Ili River Delta. The Ili River looks especially promising. "Caspian tigers survived the longest in the lower reaches of the Ili," according to V. G. Heptner and A. A. Sludskii, coauthors of *Mammals of the Soviet Union* (Brill Academic Publishers, 1992). The 894-mile-long Ili runs from northwestern China to Kazakhstan, finally flowing into Lake Balkhash. There it forms a large delta with vast wetlands, marshes, and thickets. "This delta still has enough healthy tugai to offer cover to good numbers of tiger prey," Pereladova says. "Without prey, there can be no tigers."

2010: The Year of the Tiger

"To be successful [as a hunter], a tiger must commit totally to the final charge," says biologist Mel Sunquist, of the University of Florida at Gainesville. "It cannot be half-hearted." Neither can efforts to reintroduce tigers in their former range. In this Year of the Tiger, what are the "Caspian" tiger's prospects? Will it return to Central Asia by the next Year of the Tiger, 2022? And what of other tiger subspecies in precipitous decline?

From 21 to 24 November, high-level emissaries from 13 countries thought to have tigers—known as tiger range states—will meet in Russia at the International Tiger Forum hosted by Russian Prime Minister Vladimir Putin. There, representatives of Russia, China, India, Nepal, Bhutan, Bangladesh, Myanmar, Cambodia, Thailand, Vietnam, Malaysia, Indonesia, and Laos will discuss a global tiger recovery program and draft a declaration on tiger conservation. According to scientist Igor Chestin, of WWF-Russia, the agreements are expected to commit the 13 countries to helping wild tigers double their populations by the year 2022. Tiger habitat management, technology for wildlife (such as remote monitoring systems), community engagement, and cooperative management of international landscapes will be major themes of the summit.

Some 1.5 million square kilometers of tiger habitat still remain in Asia. Except in the Russian Far East, these lands are restricted to small pockets largely in protected areas, according to Joe Walston, of the Wildlife Conservation Society, and colleagues. The biologists recently conducted a study of 42 tiger "source sites," which have

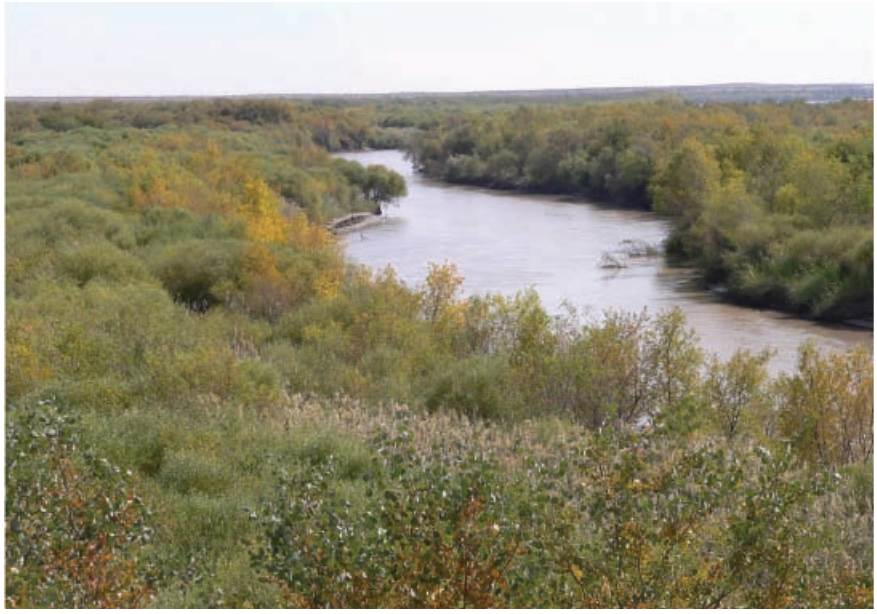
the potential to repopulate larger landscapes. Protecting these sites, Walston and other scientists believe, is essential to reversing tiger declines.

"Working within existing protected areas, we could have twenty to thirty thousand tigers by the next Year of the Tiger—if we make the commitment," says Alan Rabinowitz, president of Panthera, an organization dedicated to conserving the world's 36 wild cat species. "As a first step, we need to increase tigers at carefully chosen sites by a minimum of 50 percent over the next 10 years. To reach that goal, we have to stop poaching [for the Asian traditional medicine trade in big cat organs and bones] and the decline of tiger prey species, and better protect habitat."

The way ahead will not be easy. Russia's Amur tiger itself hovers on the brink, according to biologist Dale Miquelle, director of Wildlife Conservation Society Russia, which oversees the long-running Siberian Tiger Project. "Poaching, prey depletion, habitat loss from logging, and infectious diseases have taken down Amur tigers. Our last Russia-wide census found fewer than 500 tigers, even in their main habitat, the Korean pine forests of the Far East."

If Central Asia's tigers need tugai, those of the Russian Far East require taiga, or coniferous boreal forest.

Korean "cedar" pine is among the most abundant trees in Far Eastern taiga forests. However, rising global demand for the pine trees, for large-scale construction projects, garden furniture, and other products, has led to a huge increase in illegal logging. The pine forests of the Sikhote-Alin zapovednik, in which Miquelle and colleagues work, are not immune. Logging rates in the Amur tiger range more than doubled between 2000 and 2008. In response, Russia has listed the Korean pine in Appendix III of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Exports of Korean pine timber from Russia now need CITES permits, making it harder for the illegal timber trade to continue.



Once widespread throughout the Central Asian desert and plains, tugai, a low-growing riparian forest, still lines the edges of the region's largest rivers—the Syr Darya, Amu Darya, Murghab, Tedzhen, Ili, Zeravshan, Vakhsh, and Naryn. Photograph: Olga Pereladova, WWF.

Amur tiger conservation depends on protecting the Korean cedar pine. The tigers' prey, such as wild boars, survive on pine nuts from these trees as much as Bukhara deer in Central Asia do on the vegetation of the tugai. "No cedar [Korean pine], no Amur tigers," Chestin says.

His words echo those of an early 1900s Russian trapper and guide, Dersu Uzala, who lived in the Sikhote-Alin Mountains northeast of Vladivostok. Dersu often crossed the track of the tiger. On one hunting expedition, the hairs on his neck suddenly prickled: A tiger quietly padded through the forest not three feet from the trapper's trail. "What you want?" Dersu reportedly asked the tiger. "We go along path, no hurt you. Why you come along behind? No enough here for us all?"

That, Miquelle says, is indeed the crux of the matter. Participants in an international conference on Amur tigers in Vladivostok in March resolved to address threats to the tigers' future, among them logging in Russian Far East wildlife refuges. "Logging means roads into wilderness," Miquelle says. "Where there are roads, there's better access for poachers. Losing a tree can mean losing a tiger."

Official estimates of Amur tiger numbers in Russia come from full surveys conducted once every 10 years; the last such all-Russia survey was in 2005. But a yearly monitoring program of 16 Russian tiger locations tracks changes between full surveys. In 2005, 115 adult tigers were counted at the 16 sites. In 2009, only 56 tigers were found there.

John Seidensticker, a tiger biologist at the Smithsonian Institution in

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Washington, DC, and chairman of the Save-the-Tiger Fund, which supports the annual monitoring project, hopes it will "warn of coming dangers for tigers—in time to allow us to correct them."

The most recent concern is disease. Galia, the last study animal of the Siberian Tiger Project, was killed in June, shot in the Russian village of Terney because of the danger she posed to local citizens. The tigress had abandoned a three-week-old litter of cubs and wandered into Terney looking for a meal. All attempts to scare her away failed. Galia was the fourth radio-collared tiger to die in the past 10 months of natural causes or of conflict with humans when the tiger unnaturally lost its fear of people. "This abnormal behavior suggests disease, maybe neurological," Miquelle says. "We now think that all recent tiger deaths may be disease-related."

Scientists suspect the cause may be canine distemper, a viral illness diagnosed in other Amur tigers and common in the Russian Far East in domestic cats and dogs. "An epidemic sweeping through the region could wipe out this tiger population," Miquelle says.

For the former Caspian tiger, though, there is hope on the horizon. "Conservation geneticists usually tell us what we can't do," says Eric Dinerstein, chief scientist and vice president for conservation science at WWF. "With the discovery of the relatedness of the Caspian and Amur tiger, geneticists are saying what we can do."

Despite the drop in Russia's wild tiger numbers, proponents of an Amur tiger reintroduction in Central Asia believe the effort is an important step. It would allow for restoration of the tigers' natural range, they say, and hedge against the risk of extinction facing all small populations from factors such as disease. The tigers also may come from captive-bred Amur tigers. With behavioral training to hunt in the wild, some biologists believe, Amur tigers in zoos around the world offer another source for translocation. Is the seemingly impossible—returning tigers to Central Asia—in fact possible?

This autumn landscape shows the Sikhote-Alin Biosphere Zapovednik (reserve) on the coast of the Sea of Japan. The brackish lake, called Blogadotna, which loosely translates as "thankful place," harbored a small fishing village in the 1950s but is now fully protected under Russia's zapovednik system. The area is prime habitat for red and sika deer and, thus, for tigers. Photograph: John Goodrich, Wildlife Conservation Society.

A wild Amur tiger bursts from a cage after being rescued from a poacher's snare by personnel from the Wildlife Conservation Society and Russia's Inspection Tiger. The tiger was found by field workers conducting a survey of tiger prey species. Aside from minor abrasions from the snare cable, the tiger was unharmed. Photograph: John Goodrich, Wildlife Conservation Society.

If there is magic in an animal, it is contained in the tiger, believes wildlife biologist George Schaller, vice president of Panthera. Alan Rabinowitz agrees.

"The energy in a place with large predators is an overwhelming force," Rabinowitz says. "It makes you realize there are things much greater on Earth than you."

Bringing back the Caspian tiger would provide a means of conserving "'tiger-ness,'" Dinerstein says. He defines "tiger-ness" as adaptations for thriving in wilderness forests, including the low-growing forests of the tugai. "With the Caspian tiger, we might be able to 'reincarnate' a big cat we thought was gone forever." Then Tigrovaya Balka can reclaim its rightful name: a former river channel where tigers indeed dwell.

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