An official with Malaysia's Department of Wildlife and National Parks holds one of 50 rhino horns that it seized in August 2018. Together, the horns were worth $50 million. | Manan Vatsyayana/AFP via Getty Images

Fake rhino horns were supposed to foil poachers. What went wrong?

Why buzzy tech often fails to protect wildlife.

By Benji Jones | @BenjiSJones | Oct 18, 2021, 8:30am EDT

Down to Earth

The biodiversity crisis, explained

Several years ago, a Seattle-based tech startup called Pembient turned heads when it

The idea sounded simple: Hunters are killing rhinos for their valuable horns, so flooding the market with synthetic but otherwise identical horns could undermine demand for the real thing. It's a creative approach to the plight of rhinos, a problem that conservation groups have long struggled to solve. "Can we save the rhino from poachers with a 3D printer?" read **one headline** in 2015.

Fast-forward to today and neither Pembient nor any other tech firm has disrupted the market for rhino horn. The startup is out of money and far from developing a commercial product. A few other similar efforts have popped up here and there — most recently **in 2019**, when scientists said they could make synthetic horns out of horsehair — but these products have yet to catch on.

At the same time, companies like Pembient have stoked a debate among scientists over the value and ethics of synthetic animal parts in the campaign against poaching. Some researchers argue that selling fake horns could disrupt the market and help save rhinos, while a more vocal group of organizations says doing so could subvert law enforcement and prop up illegal trade.

The debate also raises questions about the role of tech in wildlife conservation. Though often perceived as a scientific problem, the biodiversity crisis is **equally** a social, political, and economic issue. Experts told Vox that high-tech approaches sometimes overlook the roots of the crisis, from the economic drivers of poaching to the political underpinnings of habitat loss. Cutting-edge tools can help, they say, but only if they're developed to address the whole picture of biodiversity — and in partnership with those who are directly involved in conservation.

A rare black rhino in Lake Nakuru National Park, Kenya. | James Warwick/Getty Images

The big idea: Flood the market with fake rhino horns

Earth is home to five rhino species, three in Asia and two in Africa, and most of them are threatened with extinction. The number of Africa's critically endangered black rhinos, for example, is down more than 90 percent, from around **70,000 in 1970 to roughly 5,500** today. (That's up from an all-time low of about 2,400 rhinos in the 1990s.)

Poaching is a major force behind these declines. Hunters kill rhinos and saw off their horns, which are incredibly valuable in the underground market, selling for roughly $4,000 to $8,000 per pound, raw, according to **one 2019 report**. Many horns, which can weigh several pounds each, are sold in China, Vietnam, and other East Asian countries. Some people consume rhino horn powder as a salve for various ailments, **such as hangovers and cancer**, or carve them into valuable trinkets that tend to signify wealth, according to Michael 't Sas-Rolfes, an economist and wildlife trade expert at the University of Oxford.

For decades, environmental groups have sought to fight poaching with law enforcement and campaigns to change consumer behavior around rhino horn in East Asia. Some of these efforts have helped — poaching rates are down from **their peak** in the mid-2000s — but rhinos, which play a key role in the ecosystem and **help maintain African grasslands**, continue to perish.

Pembient sought to tackle the problem head-on when it launched in 2015. "By creating an unlimited supply of horns at one-eighth of the current market price, there should be far less incentive for poachers to risk their lives or government officials to accept bribes," Matthew Markus, Pembient's founder, **wrote** on Reddit not long after the company launched.

A cup carved out of rhino horn from the early 17th century in China. | Sepia Times/Universal Images Group via Getty Images

To this day, rhino horns are carved and sold as trinkets in markets in East Asia. Here, another cup, possibly from China. | SSPL/Getty Images

The company originally focused on developing synthetic rhino horn powder — the substance that some consume for its perceived medicinal properties — but it eventually pivoted to developing physical synthetic horns with **3D printing techniques**.

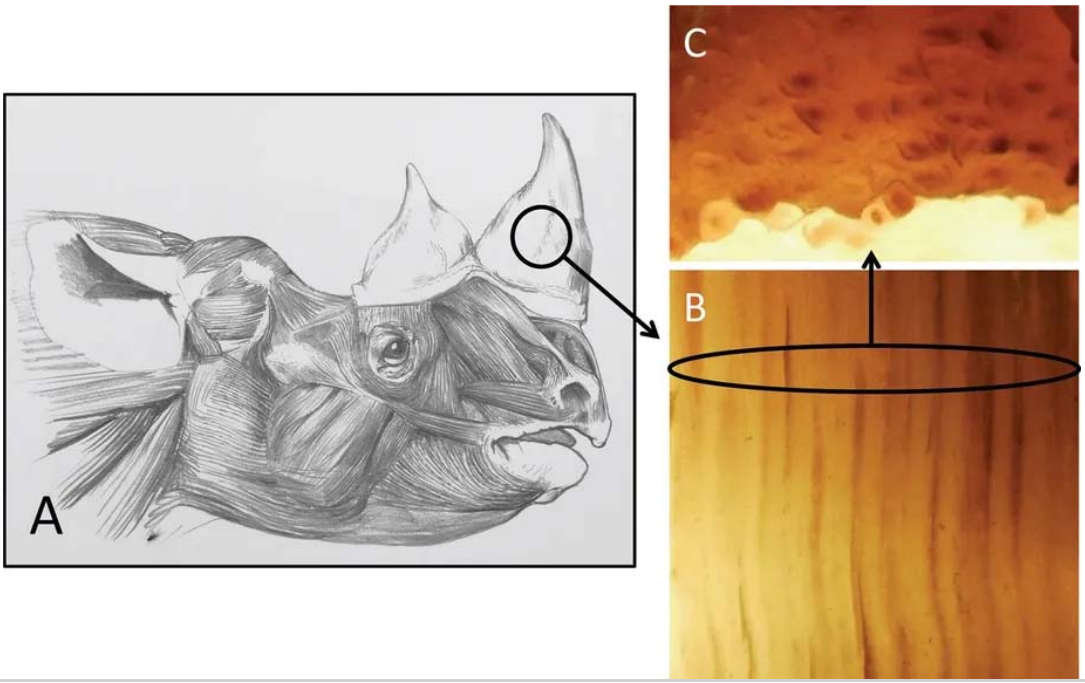
people looking to buy carvings are less likely to care whether they're sourced from the real thing.

A handful of other companies with similar ideas have sprung up over the years, including US-based firms Rhinoceros Horn LLC and Ceratotech. None seem to have infiltrated the market in a serious way.

Huyen Hoang, the co-founder of Rhinoceros Horn LLC, which **set out in 2012 to make a synthetic horn powder**, told Vox his company "pioneered" the concept of synthetic horn and actually got its product into stores. He declined to say how much of it the company sold or whether it's still on the market. The company has no online presence. Hoang suggested that Rhinoceros Horn LLC clashed with conservation groups, which saw the poaching crisis differently. "Too much politics for me and my co-founder," he said.

The founder of Ceratotech, Garrett Vygantas, said his company still plans to grow rhino horns from scratch in a lab, but it needs more money to develop the product. "A viable prototype will require a sizable investment, which is where I'm held up," he told Vox.

Meanwhile, in 2019, researchers at Oxford and Fudan University in Shanghai **published a paper** showing that synthetic rhino horns can be made by bundling together tail hairs from a horse. "We leave it to others to develop this technology further with the aim to confuse the trade, depress prices and thus support rhino conservation," Fritz Vollrath, a professor at Oxford and a study author, **said** in a statement.



A drawing of a rhino with two microscopic views — length-wise (B) and a cross-section (C) — of a real rhino horn, which consists of tightly packed hairs. | Ruixin Mi, et al./Nature

Would synthetic horns curb poaching?

There's not a ton of research into this question, but two studies suggest that identical fakes could, in fact, lower the cost and undercut the supply of authentic horns.

"Economic principles tell us that the availability of synthetic horns can reduce the supply of wild horns — and even drive out wild horn sellers completely from the horn market," Frederick Chen, an economist at Wake Forest University, wrote in **one of the studies**, published in the journal *Ecological Economics* in 2017. (Chen is also a co-author on the **other study**, along with 't Sas-Rolfes, which similarly suggests that synthetic horns could reduce poaching under certain conditions. It was published earlier this year.)

According to Markus, trust among consumers would erode if they learned the market was full of fakes, which in turn would reduce the value of authentic horns. For example, if a would-be buyer thinks there's a 50 percent chance that a horn product might be fake, they might pay 50 percent less for it. "They are going to be much more hesitant to transact," Markus said — and that could ultimately limit the incentive to kill rhinos.

But many conservation and animal welfare groups aren't convinced. They say the situation on the ground is far more complicated than what economic models can tell us — and that making fake horns, let alone with 3D printers, is simply a bad idea.

One of the most compelling arguments against the technology is that it could stymie law enforcement and possibly even provide a legal cover for illicit trade.

Under a global treaty called CITES, which regulates the trade of thousands of plants and animals, transporting rhino horns internationally is illegal. It's not clear whether the treaty would apply to synthetic horns, if they're indistinguishable from the real thing. And if it doesn't, enforcement officers would need a way to tell real horns from fake ones in order to determine what is and isn't illicit. Poachers trying to transport wild horns could otherwise claim that their haul is fake.

"It gives a cover to poachers," said Jonathan Kolby, a wildlife trade consultant and former wildlife inspector at the US Fish and Wildlife Service. "Their alibi can be, 'Oh, it's a fake and therefore not a crime.'

One possible way around that issue, according to Markus, is to insert a biomarker, or hidden signature, into fake horns that customs officials can detect. But, as he acknowledges, that opens up an avenue for consumers to tell them apart, too. **Research suggests** that those consumers are willing to pay more for wild horns.

Major conservation groups like the World Wildlife Fund (WWF) also worry that even fake horns could fuel the market for wild animal products and thus fuel poaching. "Creation of a synthetic rhino horn still props up the demand of rhino horn," Colby Loucks, vice president of WWF's wildlife conservation program, told Vox. In other words, it's hard to say if more fake horns would truly shrink the market for the real stuff.

According to the conservationists and scientists who spoke to Vox, so-called high-tech solutions often neglect the intricate web of social and political forces that they exist in.

Felipe Spina Avino, a conservation analyst at WWF, uses a drone to map part of a nature reserve in the Brazilian Amazon in 2017. | Carl de Souza/AFP via Getty Images

When tech does and doesn't work

Over her 20-year tenure at the nonprofit Save the Rhino, Cathy Dean, the group's CEO, has reviewed a number of ideas proposed by tech companies to stop poaching. From making rhino powder to building secret cameras to hide in horns, these products are often disconnected from the reality on the ground, and from the needs of people who manage rhino populations, Dean said.

"I have a rather cynical belief," she said, "that the rhino poaching crisis has created a commercial market for companies to try to come up with solutions that desperate and possibly gullible rhino site owners feel compelled to try, because they hope it might be the solution to all of their problems."

In one case, she explained, a company contacted Save the Rhino with an idea for a tracking device that would be inserted into rhino horns. Dean asked the company for some additional information on their product — how big was the device, how long did its battery last, etc. — that she said would help determine whether something like it could really work. In response, Dean went on, the company simply pointed her to a rendering of the device. "It was literally a computer drawing of a doughnut," she said, with no measurements or sense of scale. "I use it in lectures as an example of how science needs to be better informed by people on the ground."

conservation directly — *can* help limit poaching.

Take, for example, WWF's work in Kenya's Masai Mara National Reserve. Originally, the group had planned to use small surveillance drones to help park rangers prevent poaching. After spending a few nights with rangers in the reserve, however, Eric Becker, a conservation engineer at WWF, realized that drones wouldn't be that helpful after all. What the rangers needed instead was simple night vision, said Becker, as poachers tend to operate under the cover of darkness.

WWF provided the thermal imaging equipment — and **it worked**. "Parachuting into a place with a solution and trying to fit it around their problem," he said, "doesn't ever work." Broadly speaking, drone technology has largely failed to deliver on the promise to help curb poaching, WWF's Loucks added.

Groups hoping to help should also consider that poaching, like other drivers of biodiversity loss, is a social issue, not a matter of science or technology, according to 't Sas-Rolfes. If people consume wild rhino horn because they believe it has medicinal properties, then a synthetic version may not be an adequate replacement.

Patronizing those who consume rhino horn based on their beliefs — as Western media **sometimes does** — is probably not helping either, 't Sas-Rolfes added, noting that negative attitudes toward using rhino horn can provoke a backlash. "You've seen some consumption that's almost conspicuous," he said. Trying to transform the views of people who believe in traditional medical systems, such as traditional Chinese medicine, is not only challenging but risks "charges of insensitivity, cultural imperialism, or even racism," Hubert Cheung, a researcher at the University of Queensland in Australia, wrote in a **2020 paper**. Conservation would be more effective if scientists had a stronger understanding of traditional Chinese medicine and engaged with people who practice it, he wrote, "to ensure that interventions are culturally appropriate and socially compatible."

At least for now, the prospect of flooding the market with synthetic horns remains a hypothetical scenario. Pembient doesn't have enough money to invest in the next stage of development, Markus said, and so far it hasn't seen "great results" in the lab. That's to say nothing of the controversy surrounding these products and the regulatory hurdles they'd have to clear. "It doesn't leave us in a very good position," Markus said. "But, you know, we've yet to call it quits."

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