

Mongabay Series: Asian Rhinos

Geneticists: It's time to mix the Sumatran rhino subspecies

by Jeremy Hance on 29 May 2018



- *The Sumatran rhino populations living in Borneo and Sumatra have been genetically separated for hundreds of thousands of years.*
 - *The species as a whole has no more than 100 living individuals in the wild, and perhaps as few as 30. Another nine are in captivity.*
 - *In a recent study of Sumatran rhinos' mitochondrial DNA, geneticists argue it's time to combine the subspecies, despite the potential risks and drawbacks.*
 - *The question is given extra urgency with plans afoot to capture a female rhino in Indonesian Borneo.*
- Jessica R. Brandt, Peter J. van Coeverden de Groot, Kelsey E. Witt, Paige K. Engelbrektsson, Kristofer M. Helgen, Ripan S. Malhi, Oliver A. Ryder, and Alfred L. Roca. (2018) Genetic

In a forest in Borneo, a single two-horned rhino lives, separated from any other of her kind. Conservationists are currently planning to catch this Sumatran rhino (*Dicerorhinus sumatrensis*) and bring her into captivity, in the hope that she might contribute to saving the pummeled species. But given there are only two other captive rhinos in Borneo, neither of which has produced an heir, scientists are faced with a dilemma: Should they attempt to mate her with captive rhinos in Sumatra, even though they belong to an entirely different subspecies that hasn't mixed in hundreds of thousands of years?

"Unfortunately, the situation for Sumatran rhinos has become so dire that we can no longer hope to manage the subspecies separately," says Margaret Kinnaird, a rhino expert with WWF-International. "There simply are not enough individuals in each subspecies."

Currently, conservationists estimate that fewer than a hundred Sumatran rhinos survive in the wild. But the reality could be bleaker — maybe as few as 30 (<https://news.mongabay.com/2017/11/worst-case-scenario-there-could-be-only-30-wild-sumatran-rhinos-left/%5d>).

In 2012, conservationists formally announced a willingness to mix the subspecies, but haven't done it yet. The idea, however, is boosted by a new paper in *Journal of Heredity*, which takes a fresh look at the Sumatran rhino's genetics, focusing on mitochondrial DNA. Like Kinnaird, the paper's authors argue it's time to combine the subspecies, despite the potential risks and drawbacks.

"I can't see any other way to preserve the Borneo gene pool among living rhinos," says Alfred Roca, one of the authors of the paper with the University of Illinois at Urbana-Champaign.

But he makes the recommendation reluctantly. Structure and Diversity Among

"As a geneticist, it is disturbing to have to recommend that the two very different subspecies be combined."

Historic and Modern Populations of the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*).
Journal of Heredity, 1–13. doi:10.1093/jhered/esy019



Tam, one of two Bornean rhinos currently living in captivity in Malaysia. Photo by Jeremy Hance for Mongabay.

Genetics bears out the subspecies

Historically, taxonomists split the Sumatran rhino into three subspecies: One in Sumatra and the Malay Peninsula, known as the western Sumatran rhino (*Dicerorhinus sumatrensis sumatrensis*); another in Borneo — the smallest — dubbed the Bornean rhino (*Dicerorhinus sumatrensis harrissoni*); and one that used to roam India, Bangladesh, Bhutan and Myanmar, the so-called northern Sumatran rhino (*Dicerorhinus sumatrensis lasiotis*). Looking at 39 samples, from both living rhinos and museum specimens, Roca's team uncovered deep genetic separation between these historical subspecies.

"It looks like the museum researchers working with skulls and calipers got the three subspecies right," he says.

Today, the northern Sumatran rhino subspecies is likely gone, wiped out by poaching, deforestation and an inability to recover from increasingly small populations.

No one knows for sure how many wild Bornean rhinos are left, but it's not many. WWF has verified two or three wild rhinos, but according to Kinnaird, there are a number of forests areas that may still host rhinos in Kalimantan, the Indonesian portion of Borneo. WWF has claimed there are 15 rhinos left in Kalimantan (<http://wwf.panda.org/?264130/New-hope-for-Sumatran-rhino-in-Borneo>), but this was an estimate, not a confirmed survey of individual animals.

Combining the surviving subspecies — the Bornean and the Sumatran — would ensure the unique genetic build of the Bornean doesn't go the way of the northern. But it would also mean mixing subspecies that have been separated for around 300,000 years, making them nearly as distinct as *Homo sapiens* from Neanderthals, Roca says.



The taxidermied remains of Sumatran rhino Ipuh, who fathered three calves at the Cincinnati Zoo. Samples of his genetic material have been cryogenically preserved to be used for research and to create new calves in the future. Image courtesy of the Cincinnati Museum Center.

There are two concerns with breeding distantly related subspecies. The first is that the rhinos have diverged so far from each other that they would not be able to reproduce even if they met in the wild. However, Roca believes this is "unlikely."

The other is more pressing.

"There may be local adaptations among the Borneo and Sumatran rhinos. For example, they may have evolved for thousands of years to resist pathogens local to each island," he says.

Given this, Roca now recommends a plan suggested to him by Spartaco Gippoliti of the Società Italiana di Storia della Fauna. Instead of mixing the subspecies willy-nilly, he says, conservationists should create two distinct groups: one that is just the western Sumatran rhino and another a Sumatran-Bornean mix. Once the species is stabilized, captive western rhinos could be released in Sumatra while the Bornean mix could be sent to Borneo for rewilding.

Such a plan would require more rhinos than are currently in captivity. There are only two Bornean rhinos under human care now, neither capable of breeding naturally. Sumatra houses seven captive rhinos, but only two are proven breeders. Given this, a number of conservationists are pushing to bring as many wild rhinos as possible into captivity to create more babies. They fear that the wild populations will slowly collapse, as they have in many other places, due to so few animals being able to successfully breed.

"If Sumatran rhinos could indeed be effectively bred in captivity and the population increased, then absolutely the answer would be yes, they should all be brought into a captive setting," Roca says, though he notes he's not an expert on captive breeding. But he points to the examples of California condors and black-footed ferrets as successful analogues for captive breeding to save a species.

"At the very least, gametes and cell lines should be collected from every wild Sumatran rhino," he adds.



Rosa, who was born in the wild in Sumatra, now lives at the Sumatran Rhino Sanctuary in Way Kambas National Park. Image courtesy of Terri Roth.

Of cell lines and gametes

Sumatran rhino breeding may not happen so much naturally as artificially in the future, allowing researchers to inject genetic diversity that decades ago would have been impossible. Collecting gametes today, i.e. eggs and sperm, along with cell lines could ensure the most genetically diverse population possible.

"The gametes could currently be used for artificial insemination, even if rhinos are not physically moved," Roca says.

But cell lines may hold even more potential for injecting genetic diversity into future populations. Roca says that preserved cells could create "artificial gametes" within 10 to 20 years. Technology already exists to turn everyday skin cells into stem cells, and this has already been done for some rhino species

(<https://www.nature.com/news/2011/110904/full/news.2011.517.html>). The next step, turning stem cells into so-called artificial gametes, has yet to happen, though scientists are currently trying with mice.

One day, conservationists could use the genetics of long-dead rhinos, via cell lines, to bear new babies, Roca says. "It is not science fiction to think it will soon be quite feasible."

If it becomes reality, Roca holds out a tantalizing possibility that the Bornean rhino could be resurrected in full. Here's how: full Bornean rhinos could be born via preserved genetics and sent out to an established population of Sumatran-Borneo mix. Over time, the Bornean migrants would overtake the genetics of the Sumatran-Borneo mix, in something called the island-continent model.

"Each passing generation, the lineage would genetically resemble the Borneo rhinos more and more, and the rhinos from Sumatra less," Roca says, adding that

"eventually the 'island' gene pool is simply replaced by that of the migrants, who arrive generation after generation."

Roca calls this "the most under-appreciated concept in all of population genetics."



Estimates vary for the amount of Sumatran rhinos currently living in the wild. The official figure is as many as 100, while the worst-case scenario could be as low as 30. Another nine live in captivity in Indonesia and Malaysia. Image courtesy of Terri Roth.

Back to Borneo

All this would be far in the future. Today, the focus remains on that single Bornean rhino in Kalimantan. A successful capture is hardly guaranteed; in 2016, another rhino perished shortly after being captured by a team lead by WWF.

"If we are successful in catching the targeted rhino in West Kalimantan, it will go to a temporary sanctuary that has already been established in Kalimantan," Kinnaird says.

And the rhino might stay there. WWF is planning a permanent, multimillion-dollar sanctuary modeled after the Sumatran Rhino Sanctuary in Sumatra. But the question remains: Will there be rhinos to fill it? And is this the best use of any individuals caught?

Kinnaird says that even if the rhino is kept in West Kalimantan it could still be potentially combined with the western Sumatran subspecies via sharing eggs or sperm. But to date, in vitro fertilization hasn't worked in the Sumatran rhino.

So far, the only thing that has worked, and even then not very well, is natural breeding.

"My personal opinion is that she should be sent to the sanctuary in Sumatra where she could contribute to the breeding pool," Kinnaird says.

If so, she could be put to immediate use — not just in preserved eggs and cell lines, but, if all goes well, in good old-fashioned natural breeding.

Citation:

Banner Image: Emi and calf at the Cincinnati Zoo, the first facility to successfully breed a Sumatran rhino in captivity in over a century. Image courtesy of Dave Jenike/Cincinnati Zoo.

Article published by Isabel Esterman

