

# Sumatran rhino in dire straits

SAVING THE SPECIES FROM EXTINCTION IS PUTTING CONSERVATION EFFORTS TO THE TEST, WRITES S ANANTHANARAYANAN

**A** last-ditch push to raise sub-critical numbers of another vanishing instance of our natural heritage may call for different agencies — forestry, veterinary science, policing of poachers, political will and public support — to work together. A communication from the Centre for Macroecology, Evolution and Climate, University of Copenhagen, highlights a paper in *Oryx*, the journal of conservation efforts worldwide, which raises the question of whether the endangered pachyderm can be saved at all?



Rasmus Gren Havmøller

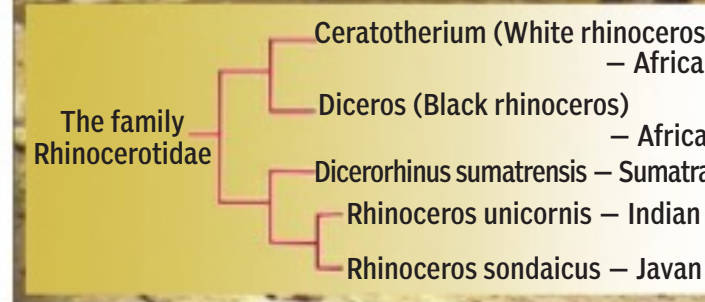
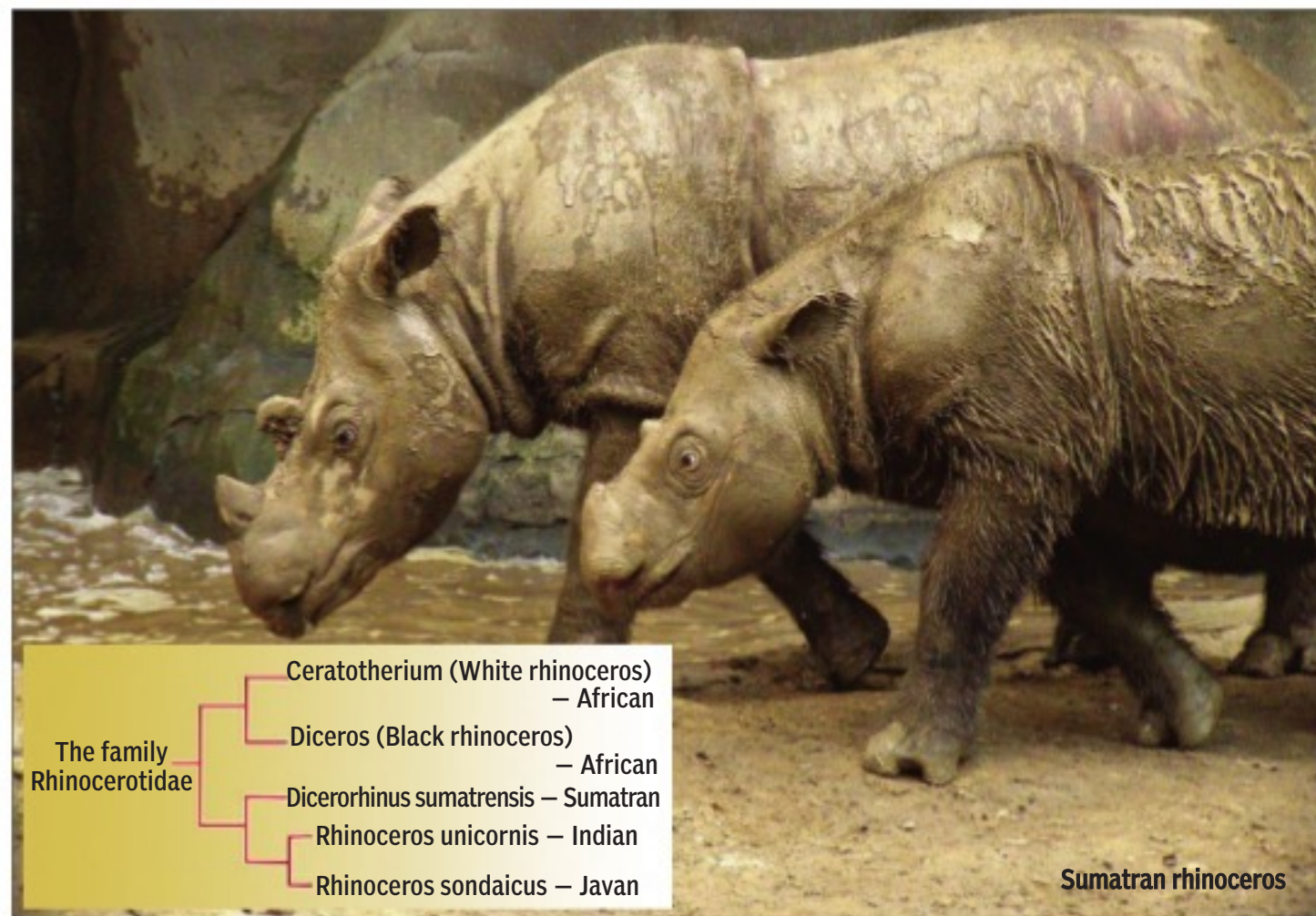
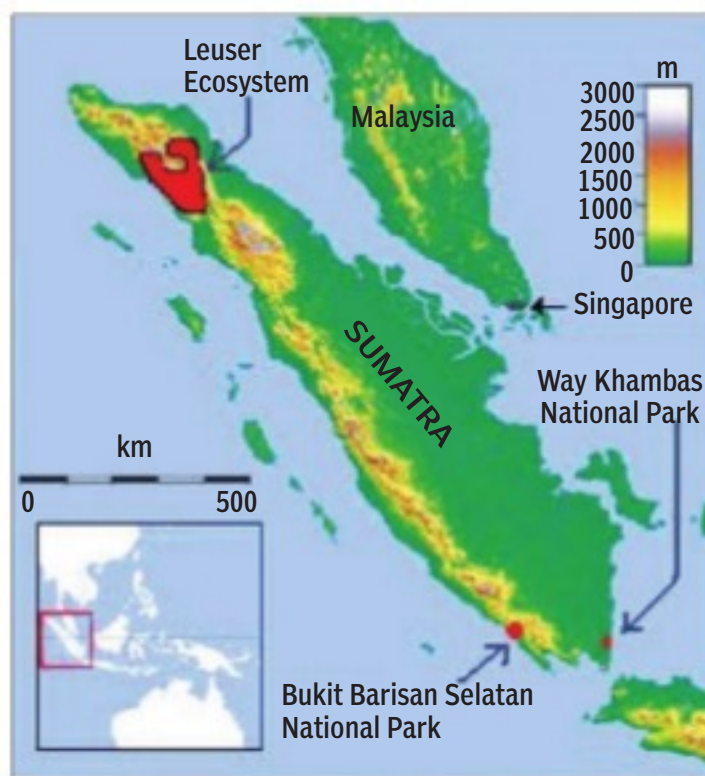
The differentiating characteristic of the rhinoceros is its horn, the African and Sumatran species having two of these and the Indian (Unicornis) and Javan one. The horn is made of keratin or the material of hair and nails and is the chief defence of the rhinoceros, to be used when provoked, as the animal is a vegetarian, living on leaves and grass. But rhino horn is prized, both for ornamental use and, what is more pervasive, because folklore has it that it has medicinal properties, and this

has proved a greater threat to the survival of the rhino than any natural predator. The rhino has, hence, been hunted and poached and while there has been loss of foraging territory due to human settlement, being hunted for its horn has been the greater reason for the species' decline in numbers.

All sub-species of the rhinoceros are threatened, but the Javan and Sumatran variety are in the greatest danger. Asian rhinos once ranged across Pakistan, India, Nepal, Myanmar, Malaysia, Sumatra and possibly even China. As rhinos do not live in herds, encroachment of grazing territory can lead to reproductive isolation and decline in numbers. But the real decimator was relentless hunting, to harvest the horn. So-called medicinal value is ingrained in traditional Chinese medicine to treat conditions like fever, convulsions, rheumatism or gout, and there is then some belief that the horn can cure snakebites, hallucinations, "devil possession", and is useful in cancer or for "detoxification". Even for the use of the powered horn for ordinary ailments, however, there is no medical evidence of effectiveness. China is a signatory to the Convention on International Trade in Endangered Species of wild fauna and flora and authoritative bodies have moved to dispel the notion of rhino horn having any medicinal value. But such is the power of belief that all of science and social organisations working to save an invaluable part of the earth's biodiversity are beating their collective head against a wall. Vietnam is the greatest market for rhino horn, which is growing with the prosperity that has come in recent decades. An article in *The Economist* said that "parts from some endangered species are worth more than gold or cocaine".

### Rescue plan

In the paper in *Oryx*, the authors review the population status of the Sumatran rhino, the threats it faces and the status of the emergency plan that was developed at a meeting of conservation organisations in April 2013 in Singapore and adopted at Bandar Lampung, Indonesia, in October the same year. While head count of the rhino is always challenging, the current estimates, based on camera traps and partial footprint surveys, show that these animals have disappeared from most places except for small pockets, almost all in Indonesia. The Way Kham-



bas National Park was estimated to have 35 rhinos in 2012, which is a strong recovery from the low of seven to 16 in 1996. But the whole of peninsular Malaysia has been found to display no sign of any survivors. Numbers of 21 and 17 rhinos have been confirmed in the Bukit Barisan Selatan National Park and the Leuser Ecosystem, and all together the count is placed at around 100.

This low number is itself a threat to survival of the species for, as the paper says, the remaining individuals are isolated, which makes breeding events rare. Attempts to breed rhinos in captivity have not been successful, both for the reason that being solitary animals they do not live well together when the female is not ready to breed, as well as for the reason that many of the females in the trials had cysts and tumours in their organs of reproduction, a condition that arises from infrequency of pregnancies.

The authors of the paper believe that reproductive health would be an area to monitor for the effectiveness of breeding efforts. In a separate communication, Rasmus Gren Havmøller, of the Natural History Museum of Denmark,

Centre for Macroecology, Evolution and Climate, Copenhagen, clarifies that the Sumatran female rhino has a gestation period of 15-16 months, which suggests it would breed every three-four years. But this may be an ideal since there is little information on what the reproduction rate actually is, he says.

A key recommendation of the 2013 summit was, hence, that all rhino populations, even in different countries, be managed as a single group, a "metapopulation", combining separate conservation efforts in a "unifying global strategy". This was the approach that has proven successful in saving the Indian rhinoceros in Nepal and Assam, in India. "A very effective management strategy that includes strict protection and moving individuals between populations and repopulating populations in suitable habitats" employed with the Indian rhino was able to increase a depleted host of "probably no more than 200 individuals in total in the early 1900s

today's number of more than 3,300", says Havmøller. The population in Assam has grown by 26 per cent in just eight years from 2006, he says, which holds out the hope that proper management could save the Sumatran rhino, too.

But implementing such measures of creating an *Intensive Protection Zone*, surveying the current known habitats, managing habitat and captive breeding and mobilising resources would take great administrative ability and political will. Christy Williams, co-author and coordinator of the WWF Asian and Rhino and Elephant Action Strategy, recalls that Project Tiger, which saved the tiger in India, owes a lot to the late Indira Gandhi, then Prime Minister.

The condition of the Sumatran rhino is more precarious than that of the tiger, whose population was 1,400 in 1973. And apart from physical conservation measures, there is the need for forceful action to contain poaching. "Similar high level intervention by President Joko Widodo of Indonesia could help pull the Sumatran rhinos back from the brink," says Williams.

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## PLUS POINTS

### A Blue Marble

Neil deGrasse Tyson from the American Museum of Natural History synchronises with Dr J Holdren, chief science advisor to the US President, and compiles inputs. Their globes are marked with boundaries and different colours denoting states, a photograph of earth unlike what is viewed in schools. This particular image allows us to see our world in a cosmic perspective — blue oceans, land, white clouds and polar ice.

In 1972, when the National Aeronautics and Space Administration's *Apollo 17* astronauts first captured our entire hemisphere, this was the view we were greeted with. It was called the Blue Marble. It was this picture that made humankind think deeply about nature, on which our civilisation depends. Despite the many distractions involving wars, civil strife and cold fronts between countries, a combination of resources allowed for a successful voyage to the moon and it was then that we got to view our world in infinite space in its entirety. Thus 1970 celebrated the first Earth Day. The same year, the Environmental Protection Agency and the National Oceanic and Atmospheric Administration were also formed. In 1972, DDT was banned and the Clean Water Act passed. One year later came the Endangered Species Act. These factors articulate the most crucial interpretation: we all have a common future on a shared planet.

We continue to live in a turbulent world even as there is no end to compiling and collating data on our rotating planet. Different images are captured a mind-boggling 13 times a day and NASA's Robotic Deep Space Climate Observatory is a specially designed camera and telescope positioned an incredible one million miles from earth that makes it possible to track global climate trends, ozone levels, vegetation and our entire world in high resolution.

President Barack Obama couldn't have endorsed humankind's responsibility better when he said on 20 July, "This Blue Marble image is a beautiful reminder that we need to protect the only planet we have."

DEEPAK RIKHYE

### Building bigger

Plant geneticist Zachary Lippman doesn't garden at home but he does cultivate his own small kitchen crop of grape tomatoes among the five acres of the fruit grown for research in Cold Spring Harbor Laboratory's fields each year. Having



Some tomato varieties, such as this one with mutations in the *la* and *fas* genes, grow interestingly shaped fruit.

studied tomatoes for nearly two decades, this associate professor at Cold Spring Harbor knows the fruit well. He's partial to plants that

produce smaller tomatoes because they "grow like weeds" compared to the many hefty varieties commonly found at farmers' markets.

Tomatoes weren't always so beefy. Much like Lippman's grape-tomato plants, wild ancestors of the domesticated crop (*Solanum lycopersicum*) bore berry-size fruit — a far cry from the SteakHouse variety of up-to-three-pounders currently sold by seed company Burpee. "Since domestication, diversity at the genome level has been significantly reduced," says Mathilde Causse, head of the genetics and improvement of fruit and vegetables department at France's National Institute of Agronomic Research in Avignon. Over time, farmers selected for larger, less lumpy tomatoes. "Now fruits are round and they are very homogeneous."

By identifying mutations affecting flowering, fruit size and shape, and nutrient content, among other characteristics, Lippman and other researchers hope to improve the agricultural output of tomatoes and other food plants.

TRACY VENCE/THE SCIENTIST

### Innovative shelter

There are more people displaced across the world and in need of shelter and support than at any point since records began, the UN Refugee Agency has said. At the end of 2014, the number of people forcibly displaced reached 59.5 million and the average length of displacement for refugees is



nearly 20 years. With no end in sight for conflicts such as the war in Syria — almost a quarter of the world's refugees are Syrian — the need for support, funding and care for those caught up in war and disasters has never been more urgent.

In this regard, a Swedish social enterprise, Better Shelter, is working with the Ikea Foundation and UNHCR to put innovative design into action in emergency settings across the world. Its shelters are designed to be more robust and durable than the tents humanitarian organisations typically supply and last for around three to six months because the metal structures and polypropylene panels of the Better Shelter units withstand harsh sunlight, strong winds and dust storms and last for at least three years.

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# ADHESION PROTEINS

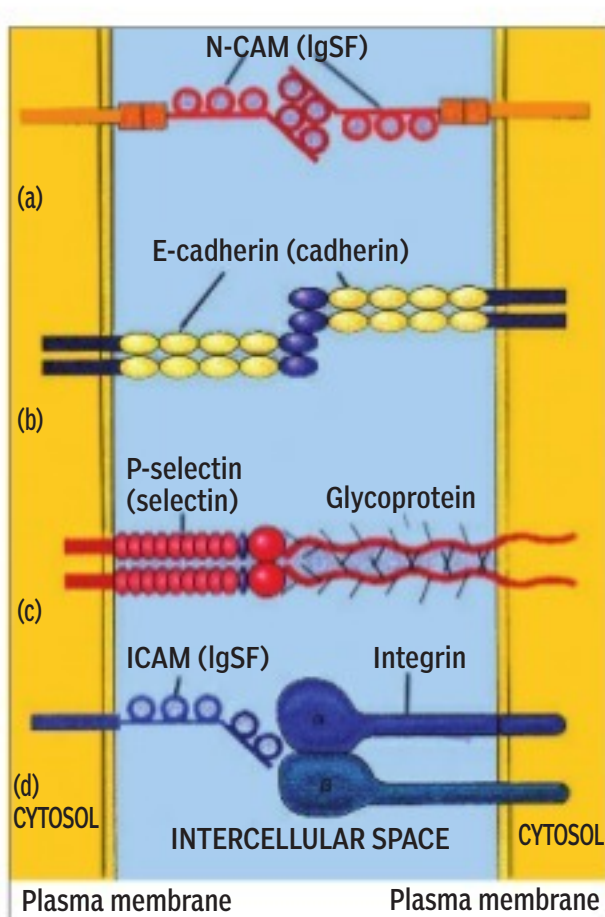
TAPAN KUMAR MAITRA PROVIDES A LOWDOWN ON THE PROCESSES BY WHICH CELLS ATTACH TO ONE ANOTHER

**T**he integrity of multi-cellular organisms depends on the ability of individual cells to associate in precise patterns to form tissues, organs, and organ systems. Such interactions require, in turn, individual cells to be able to recognise, adhere to, and communicate with each other.

Just as integrins serve as transmembrane receptors, which bind cells to the extracellular matrix, adhesion molecules serve to bind cells to one another. It is now known that such adhesion receptors fall into a relatively small number of classes. They include immunoglobulin super family proteins, cadherins, selectins, and, in a few cases, integrins. In each case, the adhesion protein on the surface of one cell binds to the appropriate ligand on the surface of a neighbouring one. In many cadherins and immunoglobulin super-family members known as CAMs, interaction happens with identical molecules on the surface of the cell whereas in others, such as selectins, the opposite takes place. As with the integrins, many transmembrane adhesion receptors attach to the cytoskeleton via linker proteins, which differ depending on the class of molecule and its location within the cell.

One way to identify molecules involved in cell-cell adhesion is to develop antibodies against specific types of cell membranes or cell-surface molecules. If such an antibody specifically perturbs cell-cell adhesion, the protein to which this antibody binds is likely involved in the adhesion process. This approach was first used successfully in the late 1970s by Gerald Edelman and his colleagues to identify a membrane glycoprotein from nerve tissue that they called neural cell adhesion molecule. When embryonic cells were exposed to antibodies directed against such N-CAMs, the cells no longer bound to one another and the orderly formation of neural tissue was disrupted.

CAMs are members of the immunoglobulin super family. Proteins in this large super family are so named because they contain domains, characterised by well-organised loops, similar to those in the immunoglobulin subunits that con-



Different types of cell-cell adhesion proteins: Cells adhere to other cells using transmembrane proteins that fall into a few main classes. These include (a) immunoglobulin superfamily (IgSF) proteins, such as N-CAM, (b) cadherins, such as E-cadherin, (c) selectins, which bind to the carbohydrates of glycoproteins on other cells, and (d) in a few cases such as leukocytes, integrins, which bind to IgSF proteins such as ICAM on the surface of endothelial cells.

stitute antibodies. IgSF members participate in a wide range of adhesion events — in the embryonic nervous system N-CAM and LI-CAM are involved in the outgrowth and bundling of neurons. Humans with mutations in the LI-CAM gene show defects in the corpus callosum (a region that connects the two hemispheres of the brain) and mental retardation among other things.

The use of antibodies that block cell adhesion also led to the discovery of cadherins, an important group of adhesive glycoprotein found in the plasma membranes of most animal cells. Like CAMs, cadherins play a crucial role in cell-cell recognition and adhesion. The two groups of proteins can be distinguished from each other because cadherins require calcium to function, which induces a conformational change allowing them to

mediate cell-cell adhesion.

Cadherins are characterised by a series of structurally similar subunits (or "repeats") in their extracellular domain. Members of the cadherin superfamily have widely varying numbers of these repeats — the best characterised one, E-cadherin, has five such repeat domains. E-cadherin molecules associate in pairs in the plasma membrane; their extracellular domains have a structure that allows them to "zip" together. At their cytosolic ends, cadherins are connected to the cytoskeleton like integrins.

The role played by different cadherins in cell-cell adhesion has been investigated in cultured fibroblasts called L cells, which bind poorly to one another and contain little cadherin. When purified DNA encoding E-cadherin or P-cadherin is introduced into L cells, they begin to produce cadherins and bind more tightly to one another. L cells that produce E-cadherin bind preferentially to other cells producing E-cadherin while those producing P-cadherin bind selectively to others producing the same. Such observations suggest that, as with CAMs, the amount and types of cadherin molecules help to segregate cells into specific tissues.

Cadherins have especially important roles during embryonic development. During the early development of vertebrates, the cells that result from early cellular divisions must adhere to one another when they organise into tissues. When early mammalian embryos are treated with antibodies that interfere with E-cadherin, or when mutant embryos cannot produce it, cells lose their tight adhesion and embryos fail to develop.

Changes in cadherin expression also occur in cancer cells. When well-defined tumours begin to metastasise and spread throughout the body, the metastatic cells lose cadherin from their surfaces. Loss of adhesion is thought to contribute to the ability of such cells to detach and migrate throughout the body.

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# Ants can 'self-medicate'

IN A FIRST, THE FINDINGS OF A STUDY RAISE QUESTIONS OVER HOW THESE INSECTS 'KNOW' THEY ARE SICK, WRITES JESSICA STAUFENBERG

**I**t appears that ants, usually seen as the ultimate self-sacrificing workers, are also not bad at saving their own skins. Scientists have shown that these insects, when infected with a life-threatening fungus, are able to "self-medicate", eating a normally harmful substance that treats the condition.

This form of "self-medication" in insects has been suspected in research circles but has never been proven until now, raising questions about how the ant "knows" it is sick.

Researchers at the University of Helsinki in Finland showed that ants infected with the fungus *Beauveria bassiana* would choose to eat small doses of hydrogen peroxide, which had been proven to reduce their deaths by at least 15 per cent. The fact that most healthy ants gave the poison a wide berth — since it usually caused a 20 per cent mortality rate — appeared to show that sick ants knew the poison would help them recover. Depending on how strong the toxic solution was, the infected ants would also either choose to eat the poison as often as normal food, or only a quarter of the time, showing they were "careful" about their selecting their doses.

Nick Bos, one of the researchers, said ants close to death in the wild also seemed to know because they often left the nest to die in isolation.

"It is not known yet how ants know they are infected, but it's very clear that they do somehow change their behaviour once they are," he told the *New Scientist*.

Jessica Abbott of Lund University in Sweden said the study stood up to scientific scrutiny. "I think this is good evidence of self-medication," she told the *New Scientist*. "They showed that the ants deliberately ingest hydrogen peroxide when infected — and that doing so increases the survival of the ant and decreases the fitness of the parasite."

The chemicals found in hydrogen peroxide are also present in aphids and decaying dead ants, leading the Finnish team to say ants in the wild may eat these to fight off infection.

David Baracchi of Queen University of London said that social insects in large colonies like ants and bees were vulnerable to disease, and a small percentage increase in survival rates against infection could make a huge difference to a colony. "It is natural that they have evolved amazing mechanisms to counteract micro-organisms, and self-medication is one of those," said Baracchi. It could be a widespread ability in the animal kingdom (a similar phenomenon has already been found in sheep), he added.

THE INDEPENDENT

