Australia, bushfires & megafauna

Introducing elephants has been suggested as a solution to the crisis Down Under, says s ananthanaryanan

BUSHFIRES in Australia are like the seasons. They destroy vast tracts every year, starting in the north in the winter and moving to the south in the summer. Every few years, the raging comes to a peak and the fires of 7 February 2009, now known as *Black Saturday*, were the deadliest on record — 400,000 hectares destroyed and 173 people dead.

David Bowman, professor of environmental change biology at the School for Plant Science, University of Tasmania, Australia, in a comment in *Nature*, has reviewed the suggestion of introducing mammoth species to restore the ecological balance and control fires.

Large, plant-eating animals that ranged the earth went extinct around 50,000- 12,000 years ago, when humans appeared on the scene. While climate changes also played a role, it was perhaps the humans, who could target the mammoths with spears, arrows and slings, who pushed the mammoths out of their feeding grounds and into extinction. Smaller animals, which presented difficult targets and reproduced faster, were able to survive.

The extinction of large animals affected the flora, with larger bushes and grasses being left to grow wild. In Australia, the extinction involved giant, kangaroo-like animals, huge lizards and large flightless birds. The food chain — of large plants being eaten and large dung and carcasses to recycle nutrients — broke down and the landscape changed. The disappearance of the mammoths created breaks in the continuity of the food web, or niches in the ecosystem, and these were left unoccupied.

The animal species which disappeared were replaced by smaller species — pigs, goats, cattle, horses, donkeys, camels, buffalo and deer — and their predators, which include the Australian wolf, and the new entrants, have been rebuilding the ecosystem. But the larger bushes have been left to grow unchecked, for animals evolve but vegetation takes longer to adapt and the Australian ecology has stayed out of balance.

Paul S Martin, who was a geoscientist at the University of Arizona, said that ecological

Professor David Bowman.

communities in North America did not function in the absence of megafauna, because much of the native flora and fauna could not turn around the path of evolution which progressed in the presence of large mammals. Things were aggravated in Australia by foreign grasses and animal species, which came with Europeans, threaten native strains and compete for resources. The early human communities followed practices of burning patches of bushland for cultivation, but with the loss of Aboriginal peoples and traditions, this practice has stopped and the growth of wild flora is unchecked. The Aboriginal practice of hunting also kept the population of smaller, wild animals down. But this is no longer the case and the animals cause more environment degradation.

The Australian government goes to great expense to deal with the problems. The methods include chemicals to control wild grasses and barriers to the spread of fires, which are expensive and only partly effective. To check animal menace, the dingo (wild dog) populations have been poisoned and even crude measures have been adopted, like tracking wild buffalo by radio collars and helicopter and shooting members of herds. The killing of the dingo disrupts their social structure and eliminates an effective way to control smaller animals like foxes, which were introduced by European settlers, and the pig and rabbit population which attack vegetation and cause erosion and habitat destruction. Ironically, it is wildlife and vegetation that are the risk factor for the environment in Australia.

Restoring balance

Professor Bowman says this approach of taming an eco-structure gone wrong may never arrive at a solution. He has proposed measures that would go to the root of the problem — which is to stabilise the food web. The two problems, of animals running amok and the flammable grasses growing wild, he says need to be tackled by predators to control the animal population and by large herbivores to check the grasslands. Stopping the poisoning of the dingo would, by itself, make for predation of the smaller animals. For larger species like the buffalo, Professor Bowman suggests making use of the large community of Aboriginal hunters in Australia. "Ranger programmes that enable indigenous people to return to their roots — by hunting buffalo or managing natural resources — have been shown to have social and health benefits for this disadvantaged sector of the Australian community," he says.

As for the menace of bushland fires, he notes that a major cause is the growth of *gamba* grass, a giant African species that has invaded the Australian plains. The grass "is too big for marsupial grazers (kangaroos) and for cattle and buffalo, but it is a great meal for elephants and rhinoceroses," Professor Bowman writes. "The idea of introducing elephants may seem absurd, but the only other methods likely to control *gamba* grass involve using chemicals or physically clearing the land, which would destroy the habitat. Using mega-herbivores may ultimately be more practical and cost-effective, and it would help to conserve animals that are threatened by poaching in their native environments."

The idea is not far different from the "rewilding" inititatives in North America. It has been noted that most living megafauna are threatened or endangered. But they continue to influence the communities they occupy, as the communities evolved in the presence of the same large animals. Reintroducing the mammoths that lived in prehistoric times, or their surviving cousins, into the environment could invigorate the "evolutionary potential" of these species and also fill the "ecological niches" that have been vacant. The idea in North America is a "Pleistocene rewilding" or the recreation of the environment of over 10,000 year ago, with camels and lions, and it has its share of critics who argue that the earth is now not the same as it was during the Pleistocene.

Nor is Professor Bowman without critics in Australia. Elephants could become the '10-tonne cane toads' of the Australian outback if they were introduced to control invasive grasses," says Patrick O'Leary of the Pew Environment Group, an active think tank and action agency.

But Professor Bowman is not blind to the challenges his idea would pose – "We could adopt management methods from game parks and reserves, such as building fences, regulating the availability of water and food and controlling breeding and hunting," he says. Using animals to deal with problems that otherwise call for huge investments and energy use could be effective and green at the same time.

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Extinct giant bird of the *Dromornidae* family, Australia.

"The Komodo dragon may be a step too far," says Professor Bowman

Biodiversity buffer

It can protect dryland from withering due to climate change, writes vibha varshney

FOR 38 per cent of the world's population that lives in dry land, the threats of desertification due to overexploitation of resources and global warming are always near. Climate change models predict an increase of 4° Celsius in average annual temperature in dry land areas by the end of the 21st century. This would reduce the ability of ecosystems to perform functions like the recycling of carbon, nitrogen and phosphorus. This, in turn, would affect soil fertility and food production.

Now for the first time a study has provided evidence that preserving the biodiversity of plants could buffer negative effects of climate change in dry land.

It is known that loss of biodiversity impairs functioning of ecosystems. These include provision of water and food, regulating services such as carbon sequestration and waste decomposition, and supporting services such as nutrient recycling. While these functions have been studied in isolation earlier, the links between biodiversity and multi-functionality have never been assessed.

Researchers did an empirical study of the links between biodiversity and multi-functionality in the dry lands that account for 41 per cent of the land surface across the globe. The study by Fernando Maestre, biologist with the Universidad Rey Juan Carlos in Spain and colleagues from 14 countries, was carried out in dry land areas spread around Argentina, Australia, Brazil, Chile, China, Ecuador, Iran, Israel, Kenya, Mexico, Morocco, Peru, Spain, Tunisia, the USA and Venezuela. Between 2006 and 2010, the team collected soil samples from 224 plots. These plots represented the main ecological features at each site. The soil samples were studied to assess 14 functions related to recycling and storage of carbon, nitrogen and phosphorus, which are indicators of soil fertility and climate regulation and are used to identify the onset of desertification processes and correlated them with the presence of perennial plants. The results indicated that biodiversity was an important attribute for the ecosystems studied, helping the soil maintain its multiple functions. Richness of perennial plants was more strongly tied to critical ecosystem services than other factors, such as annual rainfall or microbes in the soil.

"Overall we found that sites with low species richness, higher annual mean temperatures and sandy soils had lower multifunctionality and were at higher risk of losing ecosystem functionality," says Maestre and suggests that these places should immediately take action to protect their biodiversity.

Land degradation is often accompanied by loss of soil fertility. Plants would promote ecosystem resistance to desertification, says co-author David Eldridge from Australia. The study was published in the 13 January issue of *Science*.

Guy Midgley

In a commentary on the study, Guy Midgley from the South African National Biodiversity Institute in Cape Town notes the relationship between biodiversity and ecosystem function is important because socio-economic development is always accompanied by loss of natural habitat and species. He adds that erosion of biodiversity at local scales may reduce the resilience at larger spatial scales.

So, would the study help protect the environment? "Only if it influences land management, land use and land conversion in the areas which are experiencing substantial degradation. If the study had shown that biodiversity did not matter, then people would do little to protect native diversity and focus on other issues, such as erosion, fires, or invasive species," says Shahid Naeem, ecologist with the Department of Ecology, Evolution, and Environmental Biology, Columbia University, USA.

CSE/Down To Earth Feature Service

Now they can see

Controversial medical breakthrough restores vision and doctors hope to repeat the success. steve connor **reports**

TWO blind people have shown signs of being able to see again – despite having incurable eye disease – following a revolutionary operation involving the transplant of stem cells derived from a human embryo. A third patient, a Yorkshire man who volunteered to take part in a similar trial in Britain, had a similar transplant operation recently involving the injection of embryonic stem cells into the damaged retina at the back of the eye.

The three people are the first wave of patients to receive controversial transplants of embryonic cells as part of an ambitious attempt to treat a range of incurable diseases with stem cells that have the power to develop into any of the dozens of specialised tissues of the body.

The two American patients, who each received transplants in just one of their eyes last year, have not shown any signs of serious side effects, such as tissue rejection or the development of tumours, according to a study to be published in *The Lancet*.

One of the patients, a woman in her 50s, suffers from Stargardt's macular dystrophy, a progressive disease of the central retina that usually strikes between the ages of 10 and 20. The other, a woman in her 70s, has age-related macular degeneration, the leading cause of blindness in the developed world.

Although both patients have exceptionally poor vision and are legally registered as blind, their sight in the treated eye seems to have improved slightly following the transplants, even though their disease is at an advanced stage and they were not expected to recover.

The Stargardt's patient went from only being able to see hand movements to being able to see the movements of fingers, while the age-related patient went from being able to see 21 letters on a reading chart to seeing 28 letters.

"Despite the progressive nature of these conditions, the vision of both patients appears to have improved after transplantation of the cells, even at the lowest dosage," said Robert Lanza, chief scientific officer of Advanced Cell Technology, the Massachusetts company that supplied the cells. "This is particularly important, since the ultimate goal of this therapy will be to treat patients earlier in the course of the disease where more significant results might potentially be expected," he said.

In a separate clinical trial being conducted in Britain, a 34-year-old Yorkshire man suffering from Stargardt's disease underwent an embryonic stem cell transplant in his right eye recently at Moorfields Eye Hospital in London. Professor Douglas Bainbridge, a consultant surgeon there, said the operation was deliberately carried out on the patient's worst eye in order to minimise the risk to his overall vision. There were no adverse reactions and the patient was allowed to travel back to his home in Wakefield.

"There were no complications and the patient tolerated the surgical procedure well. We will be regularly monitoring the patient to follow the safety and tolerability of these transplanted cells," Professor Bainbridge said. "While this is still primarily a safety trial, we will also have the opportunity to assess any changes in visual function in the treated eye and look for signs that the injected (cells) engrafted in the retina."

Macular degeneration involves the progressive loss of cells in the retinal epithelium, the tissue layer that supports and protects the light-sensitive cells at the back of the eye. Patients with macular degeneration lose their central vision, which is important for reading and recognising faces.

"It is hoped that cell transplants might play a role in protecting people from sight loss in the future. This is a very early, small step in the development of a new, effective intervention," Professor Bainbridge said. "This is a safety trial so we are deliberately going for patients with advanced sight impairment to limit the possible damage from the stem-cell transplants. In future we'll be looking to recruit less advanced patients."

Up to 12 patients with Stargardt's disease will be recruited into the phase one safety trial in Britain, which is being run from Moorfields and Aberdeen. Different doses of stem cells will be compared for safety in preparation for a phase two clinical trial designed to assess whether the therapy can significantly restore vision.

The only other phase one clinical trial of human embryonic stem cells was designed to test their safety on patients with spinal cord injury. However, the trial was abandoned last November when the American biotechnology firm Geron announced it was pulling out of the entire field over financial concerns.

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