

SHORT SCIENCE

Peruvian popcorn is nothing new

People in what is Peru today were eating popcorn thousands of years ago, according to a study published in the *Proceedings of the National Academy of Sciences* in the US. Co-authored by Dolores Piperno, curator of New World archaeology at the Smithsonian's National Museum of Natural History and emeritus staff scientist at the Smithsonian Tropical Research Institute, the team found some of the oldest corncobs, husks, stalks and tassels, dating from 6,700 to 3,000 years ago. They were found at Paredones and Huaca Prieta, two sites on Peru's arid northern coast. Staff Reporter

Crucial evolutionary step played out again

US scientists have replicated a crucial step in evolution by which single cells evolved into multi-cellular organisms more than 500 million years ago. Using single-celled yeast, commonly used by brewers, researchers at the University of Minnesota's College of Biological Sciences have enabled it to evolve into multi-cellular clusters working co-operatively, reproduce and adapt to their environment. These multi-cellular clusters would ultimately evolve to become plants and animals. Their study has been published in the *US Proceedings of the National Academy of Sciences*. Staff Reporter

Catalina Island fox back from brink of extinction

The Catalina Island fox in California has made one of the most remarkable recoveries known for an endangered species, rebounding in just 13 years from near extinction brought on by a distemper epidemic, wildlife biologists said. The number of foxes has reached 1,542, surpassing the population of about 1,300 seen before the animals were ravaged by the disease that scientists believe was introduced by a pet dog or a raccoon from the mainland that hitched a ride on a boat or a barge. "We're beyond proud," said Ann Muscat, president and chief executive of the Santa Catalina Island Conservancy. Los Angeles Times

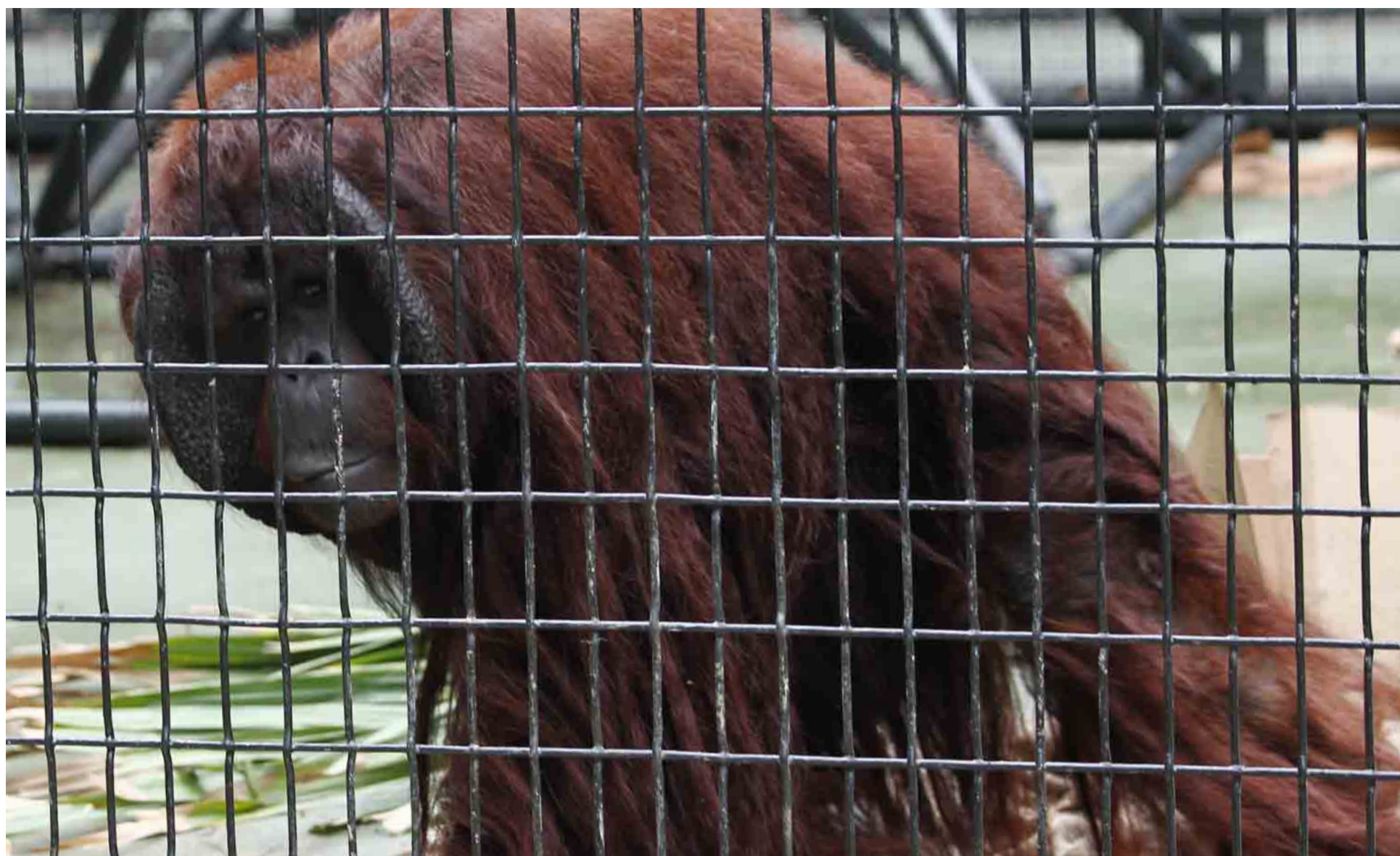


A Catalina Island fox

US in new bid to hammer out space conduct code

The United States will join with European and other nations to hammer out a code of conduct for space activities, including how to deal with the growing problem of debris circling the earth, the Obama administration says. "Unless the international community addresses these challenges, the environment around our planet will become increasingly hazardous to human spaceflight and satellite systems, which would create damaging consequences for all of us," Secretary of State Hillary Rodham Clinton said. Reuters

ANIMAL INTELLIGENCE



An orang-utan at Hong Kong's Zoological and Botanical Gardens. Many zoos, particularly in the United States, are providing electronic entertainment for their primates. Photo: May Tse

HOW COMPUTER GAMES ARE THE KEY TO HAPPY ANIMALS

Orang-utans and other creatures need to play, and touch-screen entertainment in particular provides stimulation – but don't always expect to beat them

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Ready for a game? You will be shown a sequence of five different pictures. Sometimes the pictures are abstract shapes, sometimes faces. Sometimes the faces are rotated. Memorise them: you have five seconds. Go!

Now tell me what they are in the correct sequence with 20 pictures to choose from.

If your competitor was an orang-utan, it would probably beat you at this game.

"The orang-utan has such good visual memory," says Dr Hanna Wirman, the developer of this computer game made specifically for orang-utans. They often have visual memories several times greater than humans' due to the intricate paths they have to carve out and remember in a forest of similar-looking trees.

And they will win even if the images are turned 180 degrees, because orang-utans are often upside down. "They are sensitive at recognising images no matter how they are rotated," Wirman said.

She created the game to highlight an area where orang-utans could beat humans: a kind of cross-species game play that, if implemented in zoos and wildlife rescue centres, could show visitors just how smart orang-utans – which share about 97 per cent of our DNA – are.

Wirman, who has a PhD in cultural studies from the University of the West of England in Bristol, has always been interested in games from the anthropological perspective. "Play is the least controversial

topic," she said, swivelling in her chair at Polytechnic University's M-Lab, a digital entertainment laboratory, where she has been developing the orang-utan games for the past year under a project called Technology to Orang-utans for Understanding and Communicating cross-species for greater harmony (Touch).

Like humans, orang-utans need to play, which is why Touch evolved to provide stimulation for orang-utans in captivity. The PolyU group, along with local non-profit organisation Masarang Hong Kong, has provided the Hong Kong Zoological and Botanical Gardens with touch-screen games technology.

So far, the gardens have not taken it up, though they have been in touch about the enrichment technology since May 2010.

Wirman used to study women computer-game players or other players outside the mainstream, such as the elderly, to see how and if they played differently. Now she has moved on to designing games for non-human animals. ("It's a culturally learned thing to just say 'animal', but we're animals, too," she said.)

"All mammals play," Wirman said. "Animals play in nature only when they're fully fed and all right. In captivity, they're mostly all right – so they need enrichment. They have their whole lives to play."

As early as 1925, Robert Yerkes, a prominent American primatologist and psychologist, wrote: "The greatest possibility for improvement in our provision for captive primates lies with the invention and installation of apparatus, which can be used for play or work." This introduced the

concept of environmental enrichment in captivity, at least in academia, for the first time.

Wirman says that in the decades since, most games with primates were organised by natural scientists or psychologists to study cognitive functions. But in the past few years, in the United States especially, zoos from Atlanta (whose orang-utans have been playing games on touch-screen computers since 2008) to Milwaukee (with three orang-utans playing iPad apps starting last year) have been charging ahead with technological enrichment. It can provide different kinds of games with no need



An orang-utan uses a touch screen

Zoos wonder why in 50 per cent of cases they don't get offspring ... They have to fall in love

WILLIE SMITS, FOUNDER OF INDONESIA'S BORNEO ORANGUTAN SURVIVAL FOUNDATION

for physical infrastructure, unlike physical games such as obstacle courses.

The Touch project strives for enrichment – meaning orang-utan happiness – as its goal, but is one of the first that actually allows humans to join in the game.

Two weeks ago, Wirman spent nine days in North Sulawesi, Indonesia installing the program for a pair of teenage male orang-utan twins, Is and Bento, at the Tasikoki Wildlife Rescue and Education Centre.

"[They were] so excited about the screens we brought them," she said. The games right now are simple, like the picture-matching memory game, and will remain so until she finds out more about what the orang-utans like or do not like. "In any game design, there's no point to continue developing very complicated games if there's no user testing," she said.

Wirman learned that orang-utans did not just touch the screens with their fingers but with their lips as well; they don't have the human preference for using hands.

In the future, games using motion-sensing technology (think Wii or Microsoft's Kinect) that involve full-body movement could be even closer to simulating what orang-utans do in nature.

Orang-utans, like humans, also have various personalities, so what works for Bento may not work for Is.

Dr Willie Smits, founder of Indonesia's Borneo Orangutan Survival Foundation, and a close collaborator with Wirman's project, has loftier goals for the technology as well. He wants orang-utans to be able to choose food on screen not only for themselves, but also to be able to press a button to virtually give food to another orang-utan, perhaps one they are interested in. "Zoos wonder

why in 50 per cent of cases they don't get offspring, as if matching orang-utans is one plus one," Smits said. "They have to fall in love."

He also wants to use satellite techniques so orang-utans in rescue centres or zoos can connect and learn from their counterparts in the wild, who would be filmed in their natural habitat. He wants to provide technological stimulation for orang-utans all over the world.

Touch operates using PolyU's internal funding. It is looking for industry funding starting at HK\$1 million per year for infrastructure and a small staff of researchers and programmers.

Wirman wants to develop this technology with other non-human animals as well. "Enrichment shouldn't be on the basis of if someone is intelligent or not if they suffer in captivity," she said.

Others are already doing this. Pig Chase – an iPad game being developed at Wageningen University in the Netherlands – allows humans to virtually move a ball of light on the Apple tablet to a corresponding wall in a pig pen. If the pig touches the moving ball of light, virtual sparks fly and humans see a pig snout on their screen.

And Friskies, a cat food brand, has made free iPad games for cats that simulate mice on the screen: "The bare glass screen on the iPad stands up to our cat's claws with no problems," says Friskies' website.

Meanwhile, Wirman is still in touch with the two male orang-utans from Indonesia – through Skype. They look at her on the screen. It's OK if one of them seems to be doing what looks like a human frown, lips turned down. An orang-utan has a long jaw. When his lips are curling far down, he is actually smiling.

Saving the forest for Borneo's great apes

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When Willie Smits walks through the rain forest in Borneo, Indonesia, giant adult orang-utans – with arm spans of up to two metres – come out of the trees and hug him. Then they go back into the dense forest.

"They never forget what I did for them," he said. Years ago, he saved some of those orang-utans' homes from deforestation.

He was working as a biologist in Indonesia in 1989 when he first saw a baby orang-utan peeking out from a box in a dumpster, after having lost its forest home and been abandoned. Those were "the saddest eyes" he ever saw, he said. Since then, he's worked for orang-utan rescue and welfare, starting the Borneo Orangutan Survival Foundation and the Masarang Foundation in 2001.

Orang-utans are one of the most endangered species on the planet, and live only on the two tropical islands of Borneo and Sumatra.

Smits realised that the orang-utans' fates were inextricably tied to the fate of the rain forest, which is being stripped for palm oil. For years, he appealed to people's ethics to raise opposition to palm oil's destruction of the environment, but concluded: "It doesn't work."

Now he uses technology to connect people around the world who have never set foot in a rain forest. In Earthwatchers, a collaborative software project he started with Microsoft Learning Partners, one million schoolchildren are each given a hectare of real Indonesian rain forest to monitor via satellite. If they see changes in satellite images of their plot, they can report them and Smits will send a plane to take pictures of potentially illegal logging, which can be used as evidence in court.

In a computer game that simu-

We are all losing [from forest loss]. The orang-utan is losing, the Dayak people are losing

ACTIVIST WILLIE SMITS

lates an orang-utan moving through the rainforest, pupils can compete to earn points for a trip to Borneo. The catch is that the kids are playing the game in a real patch of forest, so the minute a palm-oil company decides to cut down that part of the forest, the game ends.

"The kids say 'but this is not fair. I was winning'," Smits said. "But we are all losing. The orang-utan is also losing. The Dayak people are also losing. This is not geography or social sciences we're learning – this is the network in real life."

He also recognises the importance of the local economy, and is promoting reforestation with sugar palms to replace the palm-oil industry. "The sugar palm is a tree from heaven," Smits said. The plant can produce 65 different products, and 20 times more jobs per hectare than oil palms.

Smits' supporters include the royal family of Yogyakarta province and the Dayak indigenous people, who are losing their ancestral land to the palm-oil business. So there's hope yet for the orang-utans.

SCIENCE FOCUS WITH REINHARD RENNEBERG

Biofuels an idea that can really fly for airlines

Cathay Pacific is the latest carrier planning to cut costs by using fuel derived from a crop. Algae could do the job without taking food out of hungry people's mouths

Biofuels are getting ready for take-off in the airline industry. Cathay Pacific is banking on the hope that biofuels will cost the same as the standard fuel, kerosene, by the end of the decade – and then grow even cheaper. Kerosene now accounts for about 35 per cent of most airlines' operating expenses.

The Hong Kong airline is considering developing a biofuels supply chain in Asia for itself and its subsidiary Dragonair. If it could cut its fuel costs in half, it would save more than HK\$14 billion per year, based on the airline's figures for last year.

According to a recent *South*

China Morning Post report, the company might do much more than consume biofuels, it might create them – producing feedstock, refining the oil, building oil-storage facilities and transporting fuel to its base in the city for blending with kerosene (aircraft can only use biofuels as a 50-50 mix with kerosene). With a single refinery costing between US\$300 million and US\$500 million, this could be a multibillion-dollar investment for Cathay.

Overseas, KLM Royal Dutch Airlines has been using biofuel derived from used oil on 200 flights between Amsterdam and Paris. Lufthansa just finished a six-

month trial, making more than 1,000 successful biofuel trips between Hamburg and Frankfurt. The good news: it reduced carbon-dioxide emissions by more than 1,500 tonnes.

For an industry that is so heavily dependent on the price of oil and looking for ways to reduce its carbon-dioxide footprint, biofuels would seem to be the ideal answer. There is just one problem: what's going into the fuel tank could be feeding hungry people in the developing world.

This is a potentially volatile issue. A couple of years ago, Mexico's President Felipe Calderon blamed the soaring cost of tortillas in his

country on a reduction in corn imports after the United States stepped up production of corn-based bio-diesel.

The solution may lie with algae. Algae-based fuel, made by extracting and refining the oils – called lipids – that algae produce as they grow, would not compete with food crops. Compared with corn, algae can

Compared with corn, algae can produce 80 times more oil per hectare per year

produce 80 times more oil per hectare per year.

The problem would be a lack of water. But if we're smart about where we grow the algae, we can drastically reduce the amount of water needed for algae biofuel.

Dr Mark Wigmosta from the US Department of Energy's Pacific Northwest National Laboratory in Richland, Washington state, found that the best solution is if algae are grown in the US regions that have the sunniest and most humid climates: the Gulf coast, the southeastern seaboard and the Great Lakes.

Algae can also be grown in salt water and covered ponds.

The scientists developed a national geographic-information system to identify areas better suited for algae growth: places with flat



105b
The amount, in litres, of biofuels produced in 2010
• This represented a 17 per cent increase on the year before

land that isn't used for farming and isn't near cities or sensitive areas like wetlands or national parks.

Next, the researchers gathered 30 years of meteorological information. That helped them to determine how much sunlight algae could

photosynthesise and how warm the ponds would become.

They found that in total, 80 billion litres of algae oil could be produced with American home-grown algae. That's the equivalent of 17 per cent of the petroleum that the US imported in 2008 for transportation fuels. It could be grown on land roughly the size of South Carolina. South Carolina is a pretty large chunk of land, so this doesn't sound practical at first glance. But the area might be in coastal areas with salt water.

As carbon dioxide-consuming organisms, algae can feed off carbon emissions from power plants. Algae also digest common water pollutants like nitrogen. That means algae can also grow in – and clean – municipal waste water.

Killing two birds with one stone: US-grown oil plus environmental protection. Reinhard Renneberg has been a professor of bioanalytical chemistry at Hong Kong University of Science and Technology since 1994