

# Those who live longer have fewer children

Research into aging processes in animals with short lifespans may underestimate the price of longevity

Until not so long ago, many people shared the desire to live a long life and have lots of children. However, a look at the animal kingdom makes it clear that high fertility and longevi-

ty are often mutually exclusive. Animals with particularly short lifespans are often highly fertile, while those that live longer often have fewer offspring. Mice, for example, only live for around two years but become sexually mature after just a few weeks and have litters of three to eight babies up to eight times a year. Elephants, on the other hand, may live for up to 80 years, but elephant cows can only give birth to up to ten calves during the course of their lives. Researchers at the Max Planck Institute for Evolutionary Biology in Ploen have now discovered how the trade-off between lifespan and fertility works. A seemingly insignificant increase in lifespan can have a serious impact on reproduction. However, the researchers have yet to determine how greater longevity would affect human fertility. ([www.mpg.de/13559984](http://www.mpg.de/13559984))



Elephants can live for up to 80 years. However, an elephant cow has comparatively few offspring, only giving birth to around ten calves during her lifetime.

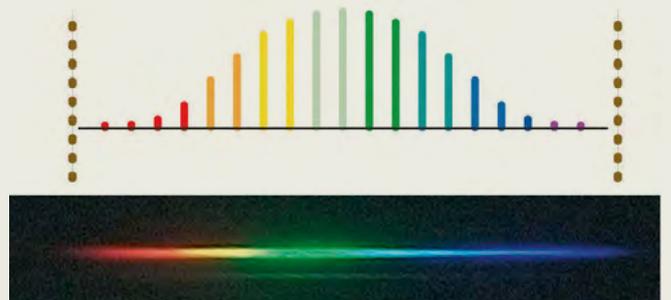
# Frequency comb trimmed for data communication

A new technology could make it possible to transmit information more efficiently in the future

A new optical component may reduce the energy required to transport data through glass fibers. Scientists at the Max Planck Institute for the Science of Light and the University of Otago in New Zealand have developed a technique with which they can create exceptionally high-quality frequency combs with the assistance of an electrical field. Frequency combs, which until now could only be generated optically, split laser beams into equally spaced sharp lines in different colors that resemble teeth in a comb. In 2005, Theodor W. Hansch from the Max Planck Institute of Quantum Optics was awarded the Nobel Prize for Physics for developing the basic technique with which laser light is split into different frequencies. The use of a frequency comb could drastically reduce the number of lasers currently required to transmit data through glass

fibers in parallel. Optical effects that distort a transmission signal could not be controlled with the frequency combs previously available. The new electro-optical frequency combs make this possible, which means that they could be used to handle the increasing volume of data in the Internet and reduce the costs of transmission. ([www.mpg.de/13669026](http://www.mpg.de/13669026), in German)

A tooth for every color: a frequency comb splits laser light into many different lines. It can now be generated more efficiently using an electro-optical effect – a development that could be useful when transmitting data.



## Self-assembling micromachines

Polarizable microrobot components can be configured to find each other in an electric field

Constructors of micromachines will be able to use a new method in future. A team led by researchers from the Max Planck Institute for Intelligent Systems in Stuttgart has presented a concept that enables the components of micro-vehicles, microrotors and micropumps to assemble themselves in an electric field. This concept is based on the dielectrophoretic effect: a non-uniform electric field electrically charges a plastic frame together with other components made of plastic or quartz glass.

During this process, the insulating components modify the electric field depending on their shape. Careful component design therefore enables them to position themselves alongside each other in precisely the format required for the construction process. This assembly concept could help construct microrobots that perform medical procedures in the human body or fit laboratory devices on a microchip. ([www.mpg.de/13724619](http://www.mpg.de/13724619))

## Origins of the potato

Numerous varieties and wild plants have made these tubers one of the most important agricultural products

The origins of the European potato have been the subject of debate for more than a hundred years. Genetic analyses performed by researchers at the Max Planck Institute for Developmental Biology have now revealed that our modern-day potato plants originated from two sources. The first potatoes collected by Europeans in the 16<sup>th</sup> century came from the Andes, in what is now Peru. In Europe, the nutritious tubers initially only developed in late fall. They were therefore very small, as they only had a short time to grow before the first frosts took hold. Other varieties were imported from Chile to Europe during the 19<sup>th</sup> century. The data obtained by the researchers showed that after the leaf and potato blight that ravaged crops during the 19<sup>th</sup> century, European farmers crossed cultivated potatoes with wild ones to make their crops more resistant to disease. The research findings therefore show how important it is to protect the diversity of species. Different varieties of



The plants with which researchers determined the origins of the European potato are up to 350 years old. They included plants collected by Charles Darwin in the Chonos Archipelago off Southern Chile in 1834.

cultivated plants and their wild-growing relatives can help protect agricultural crops from pathogens and the consequences of global warming. ([www.mpg.de/13618613](http://www.mpg.de/13618613))

## The drug crisis and its offspring

Opioid abuse in the U.S. is causing a decline in life expectancy

For many people, it begins with a seemingly harmless painkiller. However, opioid analgesics not only alleviate pain, they can also intoxicate the consumer and make them dependent. This is exactly what has happened to many patients in the U.S., who have often been taking this medication for decades and were sometimes thoughtlessly prescribed it by their doctors. The number of drug addicts and drug-related deaths has therefore increased drastically. As a result, average life expectancy in the U.S. – unlike most other industrial countries – has decreased significantly for the first time since World War I. Between 2014 and 2016, it fell by three months for men and around one-and-a-half months for women. Mortality rates rose particularly sharply among people born between 1956 and 1966. The same applies to the first male millennials, who were born between 1979 and 1989. This means that the groups most affected are the baby boomers and their children – meaning that children may copy their parents' harmful behaviors with corresponding effects on their health. ([www.mpg.de/13629156](http://www.mpg.de/13629156), in German)

# Fire weakens tropical rainforests in the long term

Even ten years after a fire, tall, mature trees continue to die in larger numbers and the forests remain more vulnerable to fire and storm damage

Tropical rainforests are crucial for biodiversity and the climate, yet they are also highly vulnerable. An international team led by scientists from the Max Planck Institute for Biogeochemistry in Jena and based at the Tanguro Ranch research station in the Brazilian Amazon has found that the

forest still shows signs of damage ten years after a fire. Even after this period, tall, mature trees continue to die in larger numbers since the air around the treetops in the decimated forest is drier and the trees consequently transpire more water than they can continue transporting in their leaves. They

are then replaced by fast-growing species that store carbon significantly less efficiently. The forest was also found to contain significantly less biomass, and the trees – particularly those at the edge of the forest – were more vulnerable to storm damage. This is an important finding, as the Amazon rainforest is increasingly being broken up by large clearings. Finally, the scientists observed that grasses migrate into the forest, make it more susceptible to natural fires. However, there was also a positive finding: just seven years after the last fire, the rainforest was already using water just as effectively as the intact forest and was also forming the same volume of biomass, albeit at a lower level.

([www.bgc-jena.mpg.de/www/index.php/PublicRelations/NewsSingle?jahr=2019&id=1561537574](http://www.bgc-jena.mpg.de/www/index.php/PublicRelations/NewsSingle?jahr=2019&id=1561537574))

Controlled fires: an experimental area after a fire laid by scientists as part of a long-term experiment.



## Humanity's oldest workshop

Stone tools were presumably invented several times in different ways

Scientists from the Max Planck Institute for Evolutionary Anthropology in Leipzig have discovered the oldest-known systematically produced stone tools in northeastern Ethiopia. Under several meters of sediment, the researchers found hundreds of small stone chips and animal bones. These finds, which date back 2.6 million years, mark a turning point in tool production: until then, early humans had merely used simple stone hammers to smash nuts or

shells. Afterwards, they began systematically striking larger pieces of rock to create smaller tools with sharp edges. These new discoveries have little in common with the stone tools found in Kenya that date back some 3.3 million years. The researchers therefore conclude that various hominins in different regions recognized the value of stone tools and invented them independently several times over. ([www.mpg.de/13529015](http://www.mpg.de/13529015))

# How humans began smoking cannabis

Findings prove that the narcotic was used 2,500 years ago in the Pamir mountains of western China

Farmers in eastern Asia have been cultivating hemp as an oilseed and fiber crop for millennia. However, most wild hemp species and the hemp varieties cultivated in the early days only contain small quantities of psychoactive cannabinoid compounds. For this reason, the question of when and how humans first realized that certain varieties of the plant had a narcotic effect has long been open to debate. A team of researchers from the Max Planck Institute for the Science of Human History working in cooperation with colleagues in China has now found tangible evidence. The researchers made the discovery while they were examining wooden

censers found in 2,500-year-old graves in the Pamir mountains. These were found to contain a chemical signature identical to that of cannabis. The data also prove that the people in the Pamir mountains burned varieties of hemp with a higher THC content. These discoveries indicate that humans burned the narcotic plants at rituals performed in memory of the dead and inhaled the smoke. To date, it has not yet been clarified whether they cultivated cannabis themselves or deliberately collected plants with a higher THC content; neither is it known whether this society used cannabis in other ways. ([www.shh.mpg.de/1338259](http://www.shh.mpg.de/1338259))



Harmless weed: wild hemp covers wide areas of the Eurasian foothills from the Caucasus to eastern Asia; however, they contain hardly any cannabinoids.

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# Infanticide by mammalian mothers

Mammalian females sometimes know no mercy when it comes to the wellbeing of their own offspring

Among some mammals, most offspring are killed by others of their species. As a rule, the males kill their rivals' offspring in the competition for food or a mate. However, researchers

at the Max Planck Institute for Evolutionary Anthropology in Leipzig have now discovered that the females of many mammalian species – such as meerkats and baboons – kill their competitors' offspring. This is particularly likely to occur when their successful reproduction is endangered by other young animals. Females can for example gain access to a burrow or enlarge their territory by killing the offspring of other females, thus driving them away. Sometimes, the females will even kill the offspring of their relatives: grandmothers may for example kill their grandchildren or aunts their nieces – even though they carry part of their own genome. The benefits for their own offspring must therefore at least compensate for this loss. ([www.mpg.de/13710950](http://www.mpg.de/13710950))



Female meerkats kill the offspring of competitors to obtain advantages for themselves and their young. The victims are often the offspring of their sisters and daughters.

Photos: iStock (top), Alecia Carter (bottom)

# The journeys of hoverflies

The animals also migrate long distances

Many animals move across the globe in response to the changing seasons. They include many species of insect – and new findings have shown that even hoverflies are numbered among them. Scientists at the University of Exeter and the Max Planck Institute of Animal Behavior in Konstanz investigated the migration patterns of two hoverfly species in the UK. They discovered that up to four billion of these insects migrate from the European mainland to the UK every spring and fly back in the fall. Such an enormous quantity of insects can pollinate billions of flowers in the UK, while their larvae can consume up to ten billion aphids. During their flight, the hoverflies also transport billions of pollen grains and distribute many tons of nutrients between the UK and Europe. Hoverflies could therefore hold a key to the preservation of biodiversity on Earth.

([www.mpg.de/13730049](http://www.mpg.de/13730049))



The marmalade hoverfly is one of 450 hoverfly species in Germany. Some adult insects overwinter here, while others fly to other regions in the fall.

## Goliath's ancestors came from Europe

The biblical Philistines appear to have descended from people who crossed the Mediterranean Sea to Israel

The Philistines are mentioned in the Old Testament as the arch-enemies of the people of Israel. The story of the fight between David, a young Israelite, and Goliath, a gigantic warrior from the Philistine camp, is legendary. However, the ancient texts say little about the origins of this race. An in-



ternational team of researchers led by scientists from the Max Planck Institute for the Science of Human History and the Leon Levy Expedition has for the first time examined genetic material from people who lived around 2,800 to 3,600 years ago in the port city of Ashkelon, which according to the Old Testament was one of the Philistines' five capitals. The analysis revealed that a European genetic component reached modern-day Israel at around the time the Philistines are believed to have arrived. This indicates that the Philistines' ancestors migrated across the Mediterranean and reached Ashkelon in the early Iron Age. However, these genetic components disappeared again within less than two centuries. Contrary to the accounts in the ancient texts, the newcomers probably married into long-established families with the result that their genetic traces were obliterated.

([www.mpg.de/13670046](http://www.mpg.de/13670046))

Searching for genetic traces: bones found in the Philistine cemetery in the city of Ashkelon provides clues to the origins of this biblical people.

# Taking time to decide

The brain replays decisions at accelerated speed

When we make decisions, various areas of our brain work together. According to researchers at the Max Planck Institute for Human Development in Berlin, some of these areas then replay these decisions at faster speeds during periods of rest. One such area is the hippocampus, which is located at the margins of the cerebral cortex and is also involved in learning and memory processes. During their study, the scientists used magnetic resonance imaging (MRI) to record the brain activities of test subjects while they were per-

forming tasks that involved decision-making and during subsequent periods of rest. The results show that the hippocampus repeats the patterns of activity typical of the preceding decision-making phase while the participants rest – but do so more quickly than before. This ability on the part of the hippocampus appears to play a central role in whether decisions once made are stored in the long term. We can then draw on these when we have to made decisions or acquire new skills. (bit.ly/370lswD)

# Always play it safe!

Management personnel don't always make the best decisions to protect themselves

Superiors should always have an eye to the employer's needs when making decisions. However, bosses often choose the poorer alternative in order to protect themselves. This alternative may be more convenient, meet with less opposition or provide the opportunity to burden someone else with the responsibility should anything go wrong. In an anonymous study of 950 management staff from all hierarchical levels of a public institution carried out by the Max Planck Institute for Human Development, 80 percent of those surveyed said that at least one of the ten most important decisions they had made during the previous twelve months was defensive. On average, around 25 percent of the most important decisions were not made in the company's best interests. Initial results show that defensive decisions are even more common in DAX companies. According to the study, the most common causes are a deficient culture of error tolerance and a lack of opportunities to discuss ideas, opinions and concerns openly within the team. Management staff are more willing to make bold decisions if failures are not stigmatized and there is a good culture of communication. (www.mpg.de/13807856)

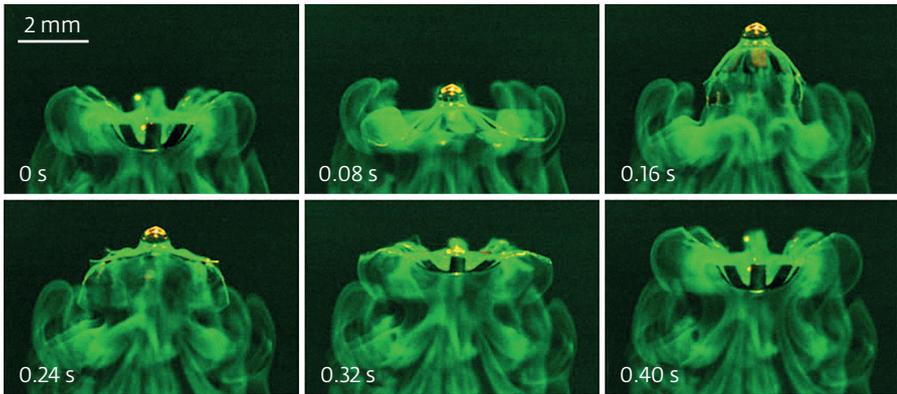
# Buoyancy for robot jellyfish

A magnetic device makes a tiny swimming robot move like a jellyfish

Marine animals have long been the inspiration for miniaturized submarines. Scientists at the Max Planck Institute for Intelligent Systems have now developed a tiny floating body just a few millimeters in size, which is made of rubber peppered with magnetic particles and looks and moves like a jellyfish. It can open and close with the help of an external magnetic field, thus enabling it to swim. In this way, the miniature swimming robot can also

capture small particles. These swimming robots could for example be used to mix liquids, dig down into the beds of bodies of water or deliver medicinal substances to specific parts of the human body. (www.mpg.de/14132439)

A swimming robot performs the dance of the seven veils: a green dye shows the eddies that a jellyfish-like robot produces when a magnetic field opens and closes it like an umbrella to make it move forwards.



Photos: MPI for Intelligent Systems / Nature Communications 2019