Candid eyes that spy on nature

A TRIAL WITH 225 CONCEALED CAMERAS IN SERENGETI NATIONAL PARK, TANZANIA, OVER A PERIOD OF FOUR YEARS IS GIVING US A WHOLE NEW VIEW OF WILDLIFE, WRITES

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Observing animals in the truly wild presents many challenges. This is nearly impossible at night and even in the day animals do not wait to be observed. Sightings, except for rare close-ups, thus need to be from a distance and we know very little about how animals behave when they are really alone. For the same reason, we do not even know all the kinds of animals there are in an area, nor even the nearly correct numbers of many of them.

Alexandra Swanson, Margaret Kosmala, Chris Lintott, Robert Simpson, Afron Smith, and Craig Packer from the Universities of Minnesota, Harvard, Oxford and the Adler Planetarium, Chicago describe in ***Scientific Data***, a trial with 225 concealed cameras in the Serengeti National Park, Tanzania, over a period of four years. The results are the first of their kind in terms of the *discretion* of observation, the quality, the statistical importance and also the quantity of information collected. We could say that the first to systematically catch animals unawares were the trappers.

They set traps — concealed pits, nets or clamps — that closed when an animal stepped on them, and the purpose was to capture them, usually for their fur. Now the idea of the trap has been turned over, using cameras instead of nets or clamps, to capture images of animals while they move around in the wild, undisturbed and unaware, and continuously, for months on end. The way the *camera trap* is sprung is either by a sensor of heat or movement, or both, and the camera takes a series of pictures, hopefully to capture images of an animal, a group of them, with their young, or a predator, an animal in flight, and so on.

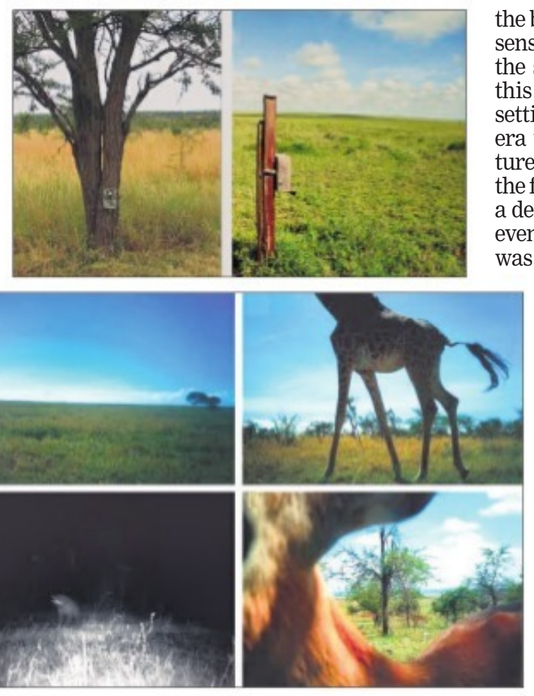
The camera trap has been in use for some 20 years, the paper in the journal, ***Scientific Data*** says, to document rare species in understudied areas or to estimate the numbers of species whose individuals could be identified.

The second use of camera traps is in fact something like the tracking done by fixing a metal or radio tag on an animal or even DNA analysis of droppings, etc. But with the advances in high resolution, automatic cameras as well as the computer processing of images, it is now possible to carry out more intensive surveys of multiple "unmarked" species, the paper says.

Snapshot Serengeti

Snapshot Serengeti, as the survey was called, stationed 225 cameras in a grid within the protected 1,125-square km National Park that lies in the 25,000-square km savannah ecosystem straddling the Kenya-Tanzania border in East Africa. The region has large numbers of wildebeest and zebra, which migrate along with the seasonal rains to the plains.

There are also a great many other species and the survey was to understand where and when predators and their prey moved in the forest and to add to an ongoing survey of the lion population since 1960 and also surveys of the herbivore population, the paper says. The camera trap grid spanned a rainfall and vegetation gradient, which would create a direction of movement and was arranged so that it covered the whole area being studied, with at least two cameras to cover the home range of each major animal species.



The arrangement was first set up in November 2010 and has been working continuously since February 2011. By 2013, each camera had been in action for 440 days and a total of 1.2 million image sets, each set consisting of one to three pictures taken together. The cameras were distributed each within a five square kilometre cell so that they covered the whole trial area. They were mounted, within steel cages, on conveniently located trees, or posts, and 50 cm from the ground to get pictures of large animals. The grass was trimmed to less than 30 cm and branches were also trimmed to avoid obstruction or false firing of the cameras.

The cameras fired at night mostly with a normal flash rather than an Infra Red flash, which had been used at first, as the latter was found to yield poor images. But what set off the camera was an IR sensor, which responded to the body heat of the animal and there were also sensors that responded to movement. At first, the sensors were set to "high" sensitivity, but this produced a lot of false triggering and the setting was fixed at "low". Each time the camera was triggered, the IR flash took three pictures, but the others took only one picture, as the flash consumes more power. There was also a delay of one minute built in between picture events to prevent continuous operation if there was a herd!

A zebra takes a closer look and a hyena makes off with a midnight snack.

The data

Dealing with 1.2 million picture sets presents a huge challenge. The pictures were first technically sorted by computers, but further inspection and classification had to be by humans. The pictures were loaded on a website of *Zooniverse*, the "citizen science" platform and the work of dealing with the million-odd pictures was carried out by 28,000 volunteers who came from the general public. Novice participants who registered for the task on the website were given guidelines for identifying 48 possible species and the software provided for simultaneous and successive viewing of sets of pictures. There was also a faster track for knowledgeable participants and 322,870 pictures were identified as those of the 48 species of animals, including the rare aardwolf and the zorilla.

Each picture was also inspected by many viewers and the findings were analysed on computers to discard indentification that was not ratified by others. Finally, a sample of a little over 4,000 pictures was viewed by a panel of "experts" and the results were used to validate the finding of the citizen viewers. As many as 96.6 per cent of the pictures were found to have been correctly identified.

The data collected represents an unprecedented set of observation, both from the viewpoint that the animals suspected no outsider, like a cameraman, as well as of the number of close pictures of animals in action. Apart from the obvious value for the study of wildlife, the authors of the paper point out that the method of data acquisition was also without precedent. "The consensus classifications and raw imagery provide an unparalleled opportunity to investigate multi-species' dynamics in an intact ecosystem… We anticipate broad interdisciplinary reuse of these datasets with applications that span basic and applied ecology, citizen-science research, machine learning and computer vision," they say.

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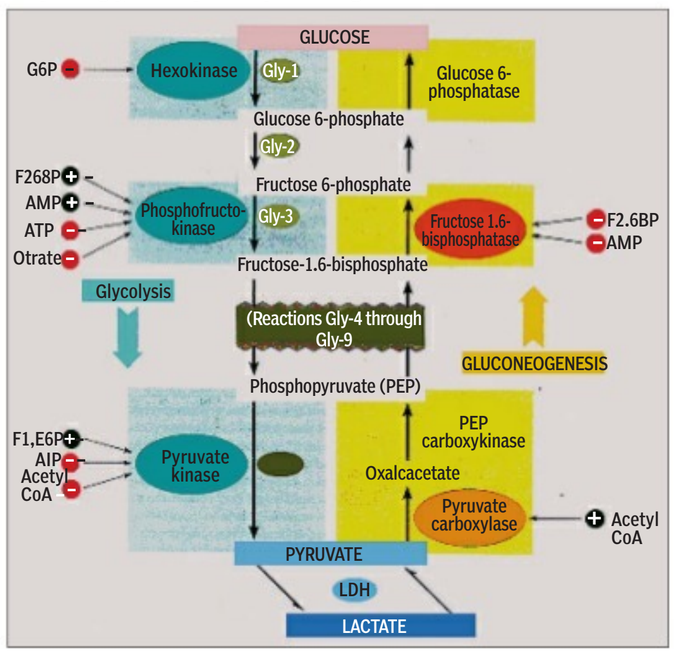
REGULATING PATHWAYS

TAPAN KUMAR MAITRA DESCRIBES TWO RECIPROCAL PROCESSES BY WHICH GLUCOSE IS GENERATED AND BROKEN DOWN IN CELLS

Cells have enzymes to catalyse the reactions of both the glycolytic and gluconeogenetic pathways, so it is crucial to keep both from proceeding simultaneously in the same cell in an obviously futile cycle. How, one may ask, can the synthesis and breakdown of glucose be controlled to keep this from happening? One way is for these pathways to operate in separate cells but is also necessary to examine another solution.

Like all metabolic pathways, glycolysis and gluconeogenesis are regulated to function at rates that are responsive to cellular and organismal needs for their products — ATP and glucose, respectively. Not surprisingly, these pathways are regulated in a reciprocal, or inverse, manner. Intracellular conditions known to stimulate one pathway usually have an inhibitory effect on the other. In addition, glycolysis is closely coordinated with other major pathways of energy generation and utilisation in the cell, especially those involved in aerobic respiration.



The regulation of glycolysis and gluconeogenesis: Glycolysis and gluconeogenesis are regulated in a reciprocal manner. In both cases, regulation involves allosteric activation (+) or inhibition (-) of enzymes that catalyse reactions unique to the pathway. For glycolysis, the key regulatory enzymes are those that catalyse the three irreversible reactions unique to this pathway (green). For gluconeogenesis, two of the four bypass enzymes (gold) that are unique to this pathway are the main sites of allosteric regulation. Allosteric regulators include acetyl CoA, AMP, ATP, citrate, fructose-1,6-bis-phosphate (F1.6BP), fruc-tose-2,6-bisphosphate (F2,6BP), and glucoses-phosphate (G6P). Acetyl CoA and citrate are intermediates in aerobic respiration. F2,6BP is synthesized by phospho-fructokinase-2 (PFK-2).

Most of the regulation of glycolysis and gluconeogenesis in animal cells involves one or both of two major control mechanism — allosteric regulation and hormonal regulation. While the former affects enzyme activity and is typically an intracellular mechanism, hormonal regulation is usually an intercellular reaction because the initiating signal is a hormone produced in another, often distant part of the body.

Allosteric regulation of enzyme activity involves the inter-conversion of an enzyme between two forms, one of which is catalytically active (or more active) whereas the other is inactive (or less active). Whether an enzyme molecule is in its active or inactive form depends on whether a specific allosteri[illegible] bound to the allosteric site, and whether is an allosteric activator or an allosteric

For glycolysis, the key regulatory enzy[illegible] okinase, phosphofructokinase-1 (PFK-1), [illegible] kinase. For gluco-neogenesis, they are [illegible] bisphosphatase and pyruvate carboxylase. Based primarily on studies with liver cells, each allosteric effector is identified as either an activator (+) or inhibitor (-) of the enzyme(s) to which it binds. Moreover, the effects of the regulatory agents make sense as they are invariably in the direction one would predict, based on an understanding of the role each pathway plays in the cell. Consider, for example, the effects of ATP and AMP. When the concentration of ATP is low and that of AMP is high, the cell is clearly low on energy, so it is reasonable for AMP to activate glycolysis. Conversely, as the ATP concentration increases and the AMP concentration decreases, the stimulatory effects of AMP lessen and the inhibitory effect of ATP on both PFK-1 and pyruvate kinase comes into play, thereby reducing the rate of glycolysis appropriately.

One may be surprised to learn that ATP is an allosteric inhibitor of PFK-1 because this enzyme uses ATP as a substrate. This seems contradictory because increases in substrate concentration should increase the rate of an enzyme-catalysed reaction.

However, this apparent contradiction can be readily explained. As an allosteric enzyme, PFK-1 has both an active and an allosteric site. The active site of PFK-1 has a high affinity for ATP, whereas the allosteric site has a low affinity for ATP. Thus, at low ATP concentrations, binding occurs at the catalytic site but not at the allosteric site, so most of the PFK-1 molecules remain in the active form and glycolysis proceeds.

However, as the ATP concentration increases binding is enhanced at the allosteric site, converting more and more of the PFK-1 molecules to the inactive form and thereby slowing down the whole glycolytic sequence.

Both the glycolytic and the gluconcogenetic pathways are also subject to allosteric regulation by compounds involved in respiration. Acetyl CoA and citrate are key players in an aerobic pathway called the tricarboxylic acid cycle. High levels of acetyl CoA and citrate indicate that the cell is well supplied with substrate for the next phase of respiratory metabolism beyond pyruvate. Therefore, it is not surprising to find that both acetyl CoA and citrate have inhibitory effects on glycolysis, thereby decreasing the rate at which pyruvate is formed. Similarly, the stimulatory effect of acetyl CoA on gluconeogenesis is consistent with the availability of pyruvate for conversion to glucose.

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Linked to creativity

STEVE CONOR REPORTS ON THE CONNECT BETWEEN SCHIZOPHRENIA, BIPOLAR DISORDER AND THINKING DIFFERENTLY

Doman philosopher Seneca the Younger famously wrote two millennia ago that [illegible] us without some [illegible] entists have now [illegible] en right. A study [illegible] 0,000 individuals [illegible] of patients diag- [illegible] or bipolar disorder are more likely than the general public to be creative professionals such as actors, dancers, musicians, visual artists or writers.

The researchers cannot be sure whether the link is due to the shared genes of family relatives or a shared upbringing and environment, but they suggested that it could be explained by similarities in the way the brain works in creative people and in patients with schizophrenia and bipolar disorder.

A previous analysis of the genomes of 86,000 Icelanders had already identified genetic traits that doubled the average risk of schizophrenia and increased the chances of bipolar disorder by more than a third. The researchers looked for the same DNA variations in the genomes of 1,000 members of Icelandic national societies representing visual artists, actors, dancers, musicians and writers and found that these creative professionals were 17 per cent more likely than non-members to carry the same genetic variants.

The scientists then compared their findings with four other studies in the Netherlands and Sweden involving a further 35,000 people. This revealed that members of the creative professions were 25 per cent more likely than other professions to carry the DNA variants linked with schizophrenia and bipolar disorder. "We are using the tools of modern genetics to take a systematic look at a fundamental aspect of how the brain works," said Kari Stefansson, chief executive of DeCode, a company based in Reykjavik dedicated to analysing the human genome with the help of Iceland's extensive medical and genealogical records.

"The results of this study should not have come as a surprise because to be creative you have to think differently from the crowd and we had previously shown that carriers of genetic factors that predispose to schizophrenia do so," said Dr Stefansson, the leader of the study published in the journal *Nature Neuroscience*.

The researchers point out that thinking differently from others has always been considered one of the hallmarks of creativity, which is why genius has so often been linked throughout history to what is widely described as "madness", with examples ranging from troubled artist Vincent Van Gogh to mathematician John Nash. "Great thinkers of the past, from Aristotle to Shakespeare, have remarked that creative genius and insanity are often characterised by the same unleashing of thoughts and emotions. This is supported by epidemiological studies demonstrating overlap be between psychiatric disorders and creativity," the scientists said.

However, other scientists said the link that the DeCode team had found, although real, was still very small. "If the distance between me, the least artistic person you are going to meet, and an actual artist is one mile, these variants appear to collectively explain 13 feet of that distance. Most of the distance between the artist and me is therefore due to other genetic variants and/or environmental factors," said David Cutler, a geneticist at Emory University in Atlanta, Georgia.

Last week, British scientists found further evidence to link genetic variations with schizophrenia, a serious mental disorder that is usually diagnosed in later adolescence or early adulthood and it marked by delusions and paranoia. Five years ago, a separate team of researchers from the Karolinska Institute in Stockholm, Sweden, found similarities in the way the brain's dopamine system – a neurotransmitter linked with a number of mental disorders – works in creative individuals and patients with schizophrenia.

THE INDEPENDENT

Experts suggest there could be similarities in the way the brain works in creative people and in patients with schizophrenia and bipolar disorder.

PLUS POINTS

Ebola drugs

The rapid spread of the Ebola epidemic has long outpaced the typical drug development pipeline and, to keep up, some researchers have turned to screening drugs already approved by regulatory bodies like the US Food and Drug Administration. On 3 June in *Science Translational Medicine*, one group reported two promising hits: an antidepressant, sertraline (Zoloft), and a calcium channel blocker, bepridil (Vascor). Both drugs prevented Ebola infection of human cells *in vitro* and significantly lengthened the survival of infected mice.

Researchers from the US Army Medical Research Institute of Infectious Diseases, the University of Virginia, and Horizon Discovery in Cambridge, Massachusetts, identified the two drugs in a screen of more than 2,600 FDA-approved compounds. Of these compounds, 171 were selected for their ability to inhibit Ebola infection in cells up to a certain threshold without interfering with normal cellular functions in monkey kidney cells. From there, the team prioritised 30 drugs based on their approval status within and outside the USA, as well as how easily they could be administered.

"It was quite shocking that some of these drugs worked," study co-author Gene Olinger, a microbiologist at the National Institute of Allergy and Infectious Diseases, told *The Washington Post*. "To be honest, we didn't think some of these would."

THE SCIENTIST

Mapping land

Simple data logging devices can help forest communities map their land and monitor environmental change, according to researchers involved in an ongoing project by an NGO, Forest People's Programme, which encourages indigenous people in Kalimantan, the Indonesian part of Borneo, to use portable, satellite-linked data loggers to create maps of areas that have not been mapped in great detail, or where existing maps are out of date.

These devices help communities visualise their rights of land use, says FPP policy advisor Marcus Colchester. "Based on the communities' own knowledge — combined with the use of these devices — they can readily make maps, which demonstrate the areas they have claims to, areas they're using and for what purposes they're using them," he says.

The first results of the trial, announced on 1 June, showed that such information can help communities make their case for access rights to land with local governments and companies with local logging licences. It can also assist conservationists who want to extend protected areas, says Colchester.

The devices are simple. Members of the Dayak community in Kalimantan were ready to map their lands after 45 minutes of training and were confident enough to pass the practical knowledge on, says Chris Phillips, mapping and Geographical Information System coordinator at FPP.

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Listen to Verdi

According to new research, slow music with a 10-second repetitive cycle has a noticeable calming effect on listeners because it matches the body's natural 10-second waves of blood-pressure control. The music of Verdi, along with the slow movements of Ludwig Beethoven's *Ninth Symphony* and the arias in Giacomo Puccini's opera *Turandot* are among the most calming pieces because they happen to be rich in 10-second cycles that match perfectly the control rhythm of the cardiovascular system, according to Professor Peter Sleight of Oxford University.

Blood pressure measurements are sent to the brain after every heartbeat, but because the brain sends control messages back to the heart along two separate nerves operating at different speeds, they arrive out of phase with one another and only come back into phase once every 10 seconds, he explained. Music with a similar 10-second rhythm was, therefore, likely to have a calming influence because it exploited this natural cycle controlling blood pressure.

THE INDEPENDENT