

The cultured chimpanzees

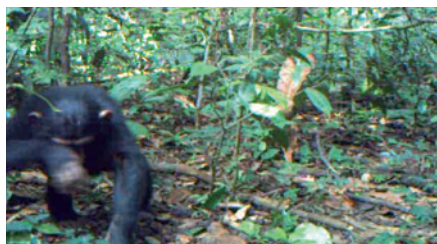
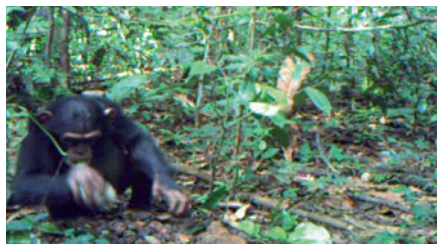
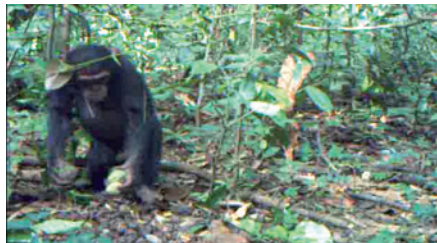
Do chimpanzees have traditions? As wild populations dwindle, researchers are racing to find out.

BY GAYATHRI VAIDYANATHAN

Thump! Thump! Thump! As the hollow sound echoes through the Liberian rainforest, Vera Leinert and her fellow researchers freeze. Silently, Leinert directs the guide to investigate. Jefferson 'Bola' Skinnah, a ranger with the Liberian Forestry Development Authority, stalks ahead, using the thumping to mask the sound of his movement.

In a sunlit opening in the forest, Skinnah spots a large adult chimpanzee hammering something with a big stone. The chimpanzee puts a broken nut into its mouth then continues pounding. When Skinnah tries to move closer, the chimp disappears into the trees. By the time Leinert and her crew get to the clearing, the animal is long gone.

For the past year, Leinert has been trekking through Sapo National Park, Liberia's first and only protected reserve, to study its chimpanzee population. A student volunteer at the Max Planck Institute for Evolutionary Anthropology (EVA) in Leipzig, Germany, Leinert has never seen her elusive subjects in the flesh but she knows some of them well. There's an energetic young male with a big belly who hammers nuts so vigorously he has to grab a sapling for support. There are the stronger adults who can split a nut with three blows. And there are the mothers who parade



In Liberia, camera traps helped researchers to get to know a young chimp, seen here cracking nuts.

through the site with their babies. They've all been caught by video cameras placed strategically throughout Sapo.

Chimpanzees in the wild are notoriously difficult to study because they flee from humans — with good reason. Bushmeat hunting and human respiratory diseases have decimated chimpanzee populations¹, while logging and mining have wiped out their habitat. Population numbers have plunged — although no one knows by exactly how much because in most countries with great apes, the animals have never been properly surveyed.

The Pan Africa Great Ape Program, the first Africa-wide great-ape census to be mounted, could change that. In addition to surveying chimpanzee numbers (see 'How many chimpanzees are left?'), project scientists plan to set up automated video and audio recording devices at 40 research sites in 15 countries with chimp populations. Led by Christophe Boesch, director of the primatology department at the EVA, and Hjalmar Kühl, also at the EVA, the programme aims to get a picture of how chimpanzee behaviour — from nut cracking to vocal calls — varies across Africa. Ultimately, the hope is to learn about the origins and extent of what, in humans, would be called culture.

MAX PLANCK INST. EVOL. ANTHROPOL.



A female chimpanzee in the Kasakela community in Gombe, Tanzania, shows her offspring how to use a stem as a tool to remove termites from a mound.

Until recently, scientists regarded culture — defined as socially transmitted behaviours — as exclusive to humans, but there is growing recognition that many animals exhibit some sort of culture. Chimpanzees, which share 98% of their genes with humans, have the most varied set of behaviours documented in the animal world. The difference between humans and animals is growing less distinct, say some researchers. “It is not black and white,” says Köhl, who is Leinert’s supervisor at the EVA.

In the old scenario, “only humans have culture,” says Jason Kamilar, a biogeographer in the department of anthropology at Yale University in New Haven, Connecticut. “Then, culture would be the defining feature of humanity, which evolved some time after the split between the human and chimp lineages,” he says. But “if chimps have culture, then presumably the last common ancestor of chimps and humans had culture”.

MAPPING BEHAVIOUR

Some chimps dance slowly at the beginning of rain showers, others don’t; some use long sticks to dig up army ants; others use short sticks. In West Africa, some chimp groups hammer nuts with a stone or a piece of wood to open them. But east of the river Nzo-Sassandra, which cuts

across Côte d’Ivoire, only one group has been seen cracking nuts.

So far, researchers have observed these variations over years spent studying groups of chimpanzee that have been carefully habituated to the presence of humans. There are just 12 such colonies in Africa (see ‘Chimpanzee census’),

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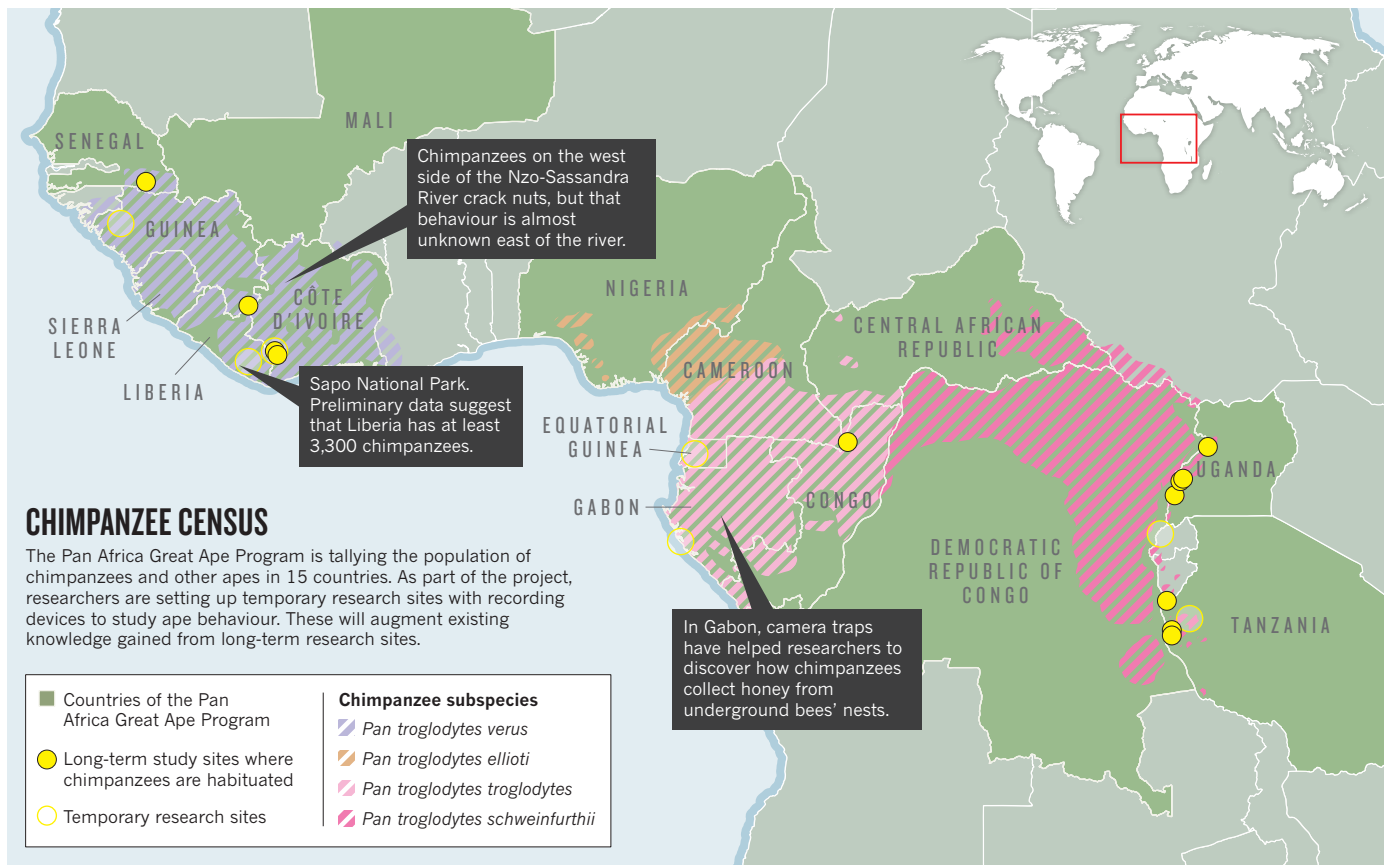
the most famous of which is in Gombe Stream National Park in Tanzania, where primatologist Jane Goodall worked.

In 1999, evolutionary psychologist Andrew Whiten of the University of St Andrews, UK, and his colleagues compiled a list of behaviours seen in seven of those groups and showed that chimpanzees have unique traditions depending on where they live². They identified at least 39 behaviours from a list of 65 that varied between groups for no obvious reason.

In humans, culture is passed on from one person to another, and in laboratory studies chimpanzees have shown the capacity to pass on learned customs. In one experiment, Whiten and his colleagues taught two chimps a complex series of steps for getting food from a box. Soon after the chimps were reunited with their groups, all the animals were using this method to get their food³. But whether such social learning happens in the wild is less clear. Gorillas and bonobos can also learn to use tools in the lab, but rarely use them in their natural habitat⁴.

Deciphering culture in the wild is difficult because researchers must ensure that behavioural differences between groups do not have other causes, such as variation in genetics or environmental conditions. “Why is it all chimps don’t do everything? One solution is that there are hidden ecological differences between populations,” says primatologist Richard Wrangham at Harvard University in Cambridge, Massachusetts. A behaviour could be linked to any number of variables such as amount of rainfall, the types of tree available, or the kinds of predator in the area, he says.

These influences can be subtle, as researchers found while studying how chimps use sticks to harvest army ants. Chimpanzees in



SOURCE: HJALMAR KÜHL

Guinea sometimes use short sticks and sometimes use sticks up to twice as long. No reason for this was obvious until Tatyana Humle, an anthropologist at the University of Kent, UK, found that some ants are more aggressive, with longer legs and larger mandibles; they run up sticks quicker and bite harder⁵. This might explain why chimps elsewhere in Africa also choose tools of varying lengths to get at ants.

But researchers have not been able to find obvious explanations for other variations related to ant harvesting. Chimpanzees in Côte d'Ivoire sweep the ants off their sticks and into their palms before eating; in Guinea, only about 320 kilometres away, the animals stick the ant-laden sticks directly into their mouths. The same type of ant is present in both places.

Ruling out genetic influences is equally complicated. This year, molecular ecologist Kevin Langergraber at the EVA and his colleagues compared genetic and behavioural data for nine groups of chimpanzee. They found that communities with greater overlap in their mitochondrial DNA showed more similarities in their behaviour⁶. "What we are saying is, you haven't really ruled out the genetic explanation," says Langergraber.

There may be a few hundred thousand chimpanzees in Africa, but researchers have studied just 700–1,000 chimpanzees at the dozen sites with well habituated colonies, says Whiten. The available information from those groups is too little to determine how genes and the environment influence behavioural

variations. Kühl compares the situation to using a handful of villages scattered around the world to draw basic conclusions about all the rituals that define human culture.

Whiten and his colleagues are now carrying out more detailed comparisons of the behaviour and ecology of chimps at all the habituated sites. But it has taken 50 years to capture the data they are using, most of which were recorded by painstaking observational studies.

The way forward may be the use of cameras hidden in strategic sites, like those Leinert and her team are setting up in Liberia. Such techniques have already proved their worth. Two years ago in Gabon, Boesch and his team were puzzled by random pits they observed in the ground. They set up camera traps and

obtained video recordings of chimps digging to extract honey from underground bees' nests — something that had never been seen before⁷. "Camera traps are proving to be an exciting way to reveal new and often complex behavioural techniques in wild chimpanzee communities," says Whiten.

CAUGHT IN THE ACT

At the site in Sapo, Leinert pulls on gloves to measure the rock used by the chimp to crack open nuts of the Guinea plum, *Parinari excelsa*. The rock is sizeable, weighing in at 880 grams. She collects nuts for later analysis, as well as hair and dung samples for genetic studies.

Leinert may later put up a video camera at the location to collect more data on the



Hjalmar Kühl (left, front) and fellow researchers are surveying Liberia's Sapo National Park to tally chimpanzee numbers. Audio (right) and camera traps in the park record chimp behaviour.

G. VAIKYANATHAN; V. LEINERT

HOW MANY CHIMPANZEES ARE LEFT?

Researchers are trekking across 15 nations to find out.

Jacob the chimp, now two years old, spends most of his day in a wooden box not much bigger than himself. Born in Sapo National Park in Liberia, he was rescued by a forest ranger, who found Jacob and his dead mother in the arms of a poacher.

Such tales are common in Africa. Bushmeat is a vital source of protein and a dead chimpanzee can fetch US\$200 in Nigeria. No one knows exactly how many chimps there are in the wild: in 2003, the International Union for Conservation of Nature made a very rough estimate of 172,700–299,700. But the population is declining rapidly, and many communities are likely to disappear in the next few decades. A study in 2008 found that the population in Côte

d'Ivoire had decreased by 90% in 17 years.

In 2010, the dearth of data prompted the Max Planck Institute for Evolutionary Anthropology (EVA) in Leipzig, Germany, to team up with the Wild Chimpanzee Foundation, headquartered at the EVA, and Conservation International, based in Arlington, Virginia, to launch the Pan Africa Great Ape Program. They aim to conduct nationwide surveys in 15 countries to estimate how many chimps are left in Africa. The scientists involved would not disclose the project's budget, but acknowledged that the surveys will be expensive and that they do not yet have all the necessary funding.

As part of the survey, graduate student Jessica Junker of the EVA and her Liberian team of graduate

students and rangers from the Forest Development Authority are walking some 400 kilometres to survey 68 squares laid out on a grid across the country. They trek through uncut bush and overgrown farms, across rivers, and into deep muddy valleys to look for chimpanzee nests. Each chimp usually builds a new nest every day, and the researchers can estimate the age of a nest from its state of decomposition. They can then extrapolate to get an idea of the number of animals in an area. Their findings so far suggest that Liberia holds at least 3,300 chimpanzees.

Using similar methods in Sierra Leone, the 2008–10 Tacugama National Chimpanzee Census estimated that more than 5,500 chimpanzees live in that country. This is much higher than a 1981 estimate of 2,500,

probably because the earlier survey used less systematic survey methods.

Christophe Boesch of the EVA, who co-heads the Pan Africa Great Ape Program, says that it will guide conservation efforts to where they can do the most good. But getting precise numbers on the great apes in each country is expensive because of the labour involved, and some conservationists would rather see the money spent on enforcing laws against poaching.

"We don't need a nationwide survey to tell us we are losing the battle," says David Greer, who coordinates the African Great Apes Program for the conservation group WWF. "We need to be more assertive, more aggressive with intervention measures, trying to stop the decline." **G.V.**

nut-cracking behaviour. The cameras are mounted in boxes on tree trunks at the height of a chimp's shoulder, and powered by rechargeable batteries. An infrared motion detector activates the camera for one minute when anything moves in its range.

Near the nut-cracking site, a solar-powered audio device is already continuously recording the forest sounds. Chimpanzees emit a range of calls, including short, high-pitched 'pant hoots' that are unique to each individual, and researchers can use them to identify individuals and to tally the size of a community. These calls may be a form of vocal culture, somewhat like human dialects⁸.

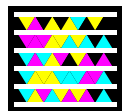
Over the next five years, the Pan Africa Great Ape Program will establish similar recording stations at locations across Africa. "So potentially we might have, in a few years, behavioural differences from 40 different populations, which is, as you know, four times more than what we have now," says Boesch.

Kühl proposes that these data could help in designing computer models to test how genes, ecology and social transmission influence the distribution and spread of behaviours such as nut cracking. One idea is that when female chimpanzees reach sexual maturity and move to new communities, they pass along their learned behaviours. Another possibility is that each group invents its own behaviours, some of which catch on and become a culture. Individual practices can die out in particular groups but thrive in others. Or, it might

be that some chimp groups refuse to take up new ways of doing things from incoming individuals. This could explain why some populations show similar behaviours and others do not.

Before Kühl and his colleagues can conduct the modelling work, they need to devise a faster way to go through the recordings made by the camera and audio traps, which are accumulating at a rate of hundreds of hours each month. Students are currently carrying out the analysis but it can take 10 hours to go through an hour of video, according to Kühl. So engineers at the Fraunhofer Institute for Digital Media Technology, based in Ilmenau, Germany, have developed a computer algorithm to recognize individual chimpanzees from their facial patterns and distinctive features, such as the wrinkles under their eyes. In tests of zoo animals, the software can correctly identify individual chimpanzees 83% of the time, and it processes recordings ten times faster than a person can.

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Nevertheless, the cameras cannot reveal how an adult chimp patrols its range, or other actions that play out over a wide area. The full portfolio of traditions in the community will remain a mystery. And automated recordings will never capture the subtle

ecological information — such as the mandible size and leg length of army ants — that may eventually explain particular behaviours. These require boots on the ground, and long-term behavioural studies are needed to see how chimpanzees pass traditions on to each other as a driver of culture.

But already, the 30 cameras that Leinert has set up in Sapo Park have delivered some tantalizing clues. She is most interested in the lively young male she calls 'Janosch', whom she likes for "his big belly and the way he strikes out to crack the nuts". Besides being entertaining, he sometimes carries his pounding rock away with him, something Leinert hasn't seen with most other chimpanzees in Sapo. The practice may yet catch on with others there. If so, Leinert could be seeing the beginnings of a cultural variation, captured by the cameras she set up in the forest. ■

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1. Köndgen, S. *et al. Curr. Biol.* **18**, 260–264 (2008).
2. Whiten, A. *et al. Nature* **399**, 682–685 (1999).
3. Whiten, A., Horner, V. & de Waal, F. B. M. *Nature* **437**, 737–740 (2005).
4. McGrew, W. C. *Science* **328**, 579–580 (2010).
5. Schöning, C., Humle, T., Möbius, Y. & McGrew, W. C. *J. Hum. Evol.* **55**, 48–59 (2008).
6. Langergraber, K. E. *et al. Proc. R. Soc. B* **278**, 408–416 (2011).
7. Boesch, C., Head, J. & Robbins, M. M. *J. Hum. Evol.* **56**, 560–569 (2009).
8. Mitani, J. C., Hasegawa, T., Gros-Louis, J., Marler, P. & Byrne, R. *Am. J. Primatol.* **27**, 233–243 (1992).