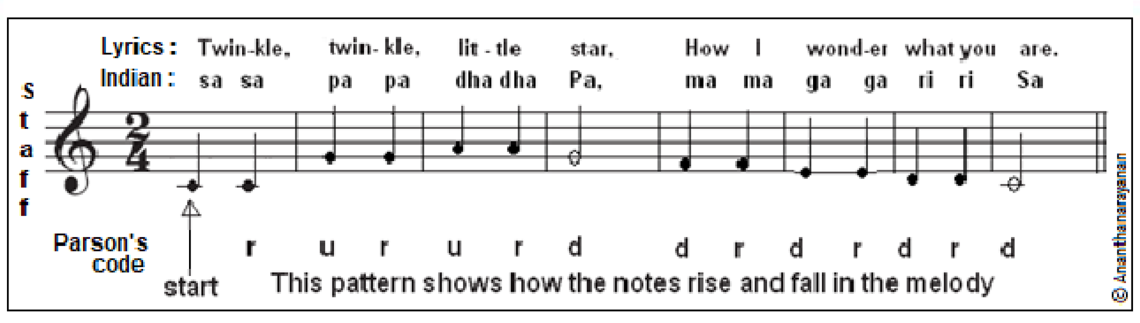
Singing dog emerges from extinction

A toehold to trace the origins of vocal communication



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While many would consider the capacity for speech as exclusively human, there is evidence of vocal communication in many species. Whales, dolphins and elephant herds are well known examples. The case of songbirds goes further, where rhythm and fixed patterns of tones, and even rudimentary grammar have been noted. While animal parallels of speech do not compare with human ability, the study of animal vocalisation, with its simplicity, and the possibility of mildly invasive experimenting, could help understand the evolution of human speech.

Suriani Surbakti, Heidi G Parker, James K McIntyre, Hendra K Maury, Kylie M Cairns, Meagan Selvig, Margaretha Pangau-Adam, Apolo Safonpo, Leonardo Numberi, Dirk YP Runtuboi, Brian W Davis, and Elaine A Ostrander, from universities and institutes in Indonesia, Sydney in Australia, Göttingen in Germany and Maryland, Florida and Texas, in the US, report in the journal, *Proceedings of the National Academy of Sciences*, a discovery that a species of wild dog, which displays the facility of vocalising with near musical quality, feared extinct, is still to be found. That specimens of this rare breed could be there for study holds out a promise of understanding the features that made it possible for humans to develop the ability to speak and sing. And from there, possibly ways to deal with vocal or speech disorders or difficulty in processing sounds.

A well-known instance of directed vocalisation in animals is seen in the simple whistles of dolphins. The pattern is variations of the pitch, which are heard and remembered by other dolphins, as the identity of individual dolphins. The whistles were studied with the help of a modern, mathematical coding of musical compositions of humans, a method that has helped computers search for instances of plagiarism or copy, over the Internet.

The method relies on patterns of rise and fall of pitch, along the melody of a piece of music. The coding avoids complexities, like actual pitch, or loudness, and the process, which is known as Parson's Code, consists of only the sequence of the pitch rising, falling or staying unchanged. The picture shows the notes that appear in the song, "Twinkle, twinkle, little star". The notes are shown in the Indian notation and in western staff notation, and, in the Parson's code, the rising, falling or steady pitch is shown, as "u" for rise, "d" for fall and as "r" when unchanged.

The code is not a way to record or reproduce a tune, but the code turns out to be unique and works as a signature for most melodies. Using this code to mark the whistles of dolphins, scientists were able to identify the signals sent out by each one and they found that the whistles of individual dolphins were unique – they identified the dolphin that made it. As the whistles thus carry information, it is believed there are other messages that they convey.

The study of birdsong is replete with patterns. It has even been shown that a particular part of the brain is affected when a familiar pattern of birdsong being heard is changed. Injury to this portion of the brain has been found to affect song recognition in canaries and the zebra finch, just like injury to some parts of the human brain leads to selective language impairment. While specific melodic forms are learnt by fledglings, from the father bird, there is evidence that specific combinations of sound convey different meanings. This finding, in the case of the chestnut crowned babbler, a songbird of South East Australia, is a rare instance, outside human communication, of meaning conveyed by rearranging sounds.

In case of the chestnut crowned babbler, it was found that out of at least 15 context specific calls, there were two groups, say A and B, apparently meaningless by themselves, but which were sounded as AB or as BAB, one specifically to maintain the flock in flight, and the other to motivate feeding, when with the young in the nest. It was possible to replay these calls from a recording and induce a bird to either look towards a window, for flight, or towards the nest – to show that the experimenter was "speaking" with the bird.

Singing dog

It is in this context of working with the simplest systems in unravelling the mystery of vocal communication, that we have a case of melodic vocalisation and symphonic group cries of the New Guinea singing dog, or the New Guinea Highland dog. The debate is still on whether this near extinct variety is the same species as the domestic dog, and it is recognised that it has been isolated from the main evolutionary stream. The characteristic of the NGSD, not seen in dogs, wolves or dingoes, is the dramatic pitch modulation of its howl. The howl starts at a pitch of 600-800 cps, or about one octave higher than normal speech, and then swings to 300 cps, or a deep human voice, and high to 1700 cps, or two octaves higher than the start. The howl lasts as long as five seconds, with abrupt rise and fall of pitch and there are five to eight well defined overtones, which give the howl a musical quality.

There is also the *chorus howl* or independent melodies sounded by more than one NGSD, where one starts and others quickly join. The participants of the chorus are said to be well synchronised, and can go on for 10 minutes, usually coming to a stop simultaneously. A unique feature that the NGSD howl displays is the "trill", a high pitched pulsed signal, "of a distinctly 'bird-like' character," and this is believed to be produced by the rapid vibration of a rudimentary uvula (the fleshy extension that hangs at the back of the soft palate).

While this instance of sophisticated vocalisation, outside the category of song birds, is an attractive opportunity to study the evolution of vocal ability, there have been no known specimens of NGSD in the wild for over 50 years and there are only 200-300 specimens in captivity. The NGSD is known to have been there in good numbers in the lowland of New Guinea, finds mention in travel records and was studied since over a century ago. But it was displaced by human colonisation and European and Asian-derived dog lines, and has been considered extinct.

This belief is now reviewed, with the current study, which identifies a high altitude dog population, the Highland wild dog, in mountains of New Guinea, as the same line as the NGSD. These, the HWD, also show vocalisation like the NGSD and the team writing in PNAS has carried out DNA analysis, which shows close similarity of the HWD and NGSD. The vocalisation and genetic proximity "indicate the potential of the HWD to be a wild NGSD population," the paper says. The HWD may have been "the founding population of the NGSD" which "is not, in fact, extinct and the HWD should be resourced for conservation efforts to rebuild this unique dog family population," the paper says.

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SILENT BUT SURE COMMUNICATION

Plants might be able to tell us about the location of dead bodies, helping families find missing people

NEAL STEWART

The notion of plants talking to us about dead people sounds like a bad horror movie. But that's the theme of a recent scientific paper I co-authored.

Each day, over 160,000 people die in the world. Most people die with family members present or nearby; their family and friends mourn their loss, which includes having the loved one's body present. Sometimes people die in the wilderness, in war and under questionable circumstances. In so many of those cases, the body is never recovered and loved ones don't get closure. In cases of murder or genocide, perpetrators go unpunished without a recovered body.

I didn't usually think about this topic, until recently. I am a plant biologist who uses biotechnology and synthetic biology approaches in research. Nearly 20 years ago, I coined the word "phytosensor" in a paper referring to plants that had been genetically engineered for sensing and reporting.

Imagine a crop plant that could tell you it was getting sick before it started to die – that was my phytosensor idea. Recently I started to wonder if native plants – those that are not engineered – could also sense and report. I found out that other people on my campus had many of the same thoughts before.

Trees have a lot to tell us

Maybe the notion of talking trees is not so far-fetched. After all plants are used to responding to changes in their environment. Given that they're rooted in place, plants really have no choice but to change their chemistry and biology when attacked by pests or face other challenges such as drought or benefit from fertiliser – by way of animal faeces. It would seem that long-lived plants like trees must respond quite well at sensing and responding to stresses, allowing them to grow tall and produce shade over decades and even centuries.

When people go missing and die – whether by natural causes or by foul play – their bodies start to decompose if the weather is warm. And if they decompose in the forest under the shade, finding and recovering their bodies can be difficult if not impossible. One solution is to learn how plants respond to decomposing humans and then "listen" to what they are telling us about the people who've died under their canopies.

The 'Body Farm' speaks

My colleagues and I at the University of Tennessee started such a conversation last year with anthropologists, soil scientists and people who study plants.

One thing that the University of Tennessee is famous for is their Forensic Anthropology Center, which is more commonly known as the "Body Farm." In the 1980s Bill Bass, an anthropology professor, founded the "Body Farm", the first research facility of its sort in the world.

Bass used donated woodland near the campus to understand the phases of human decomposition after donated human bodies are left on the surface or are buried. This outdoor facility has been a boon for vastly improving our understanding of how various organisms, such as insects, interact with dead people during various phases of decomposition. But the proverbial elephant in the room – the forest itself – has been overlooked as a responder.

Learning to listen

The paper I co-authored, which is published in a journal *Trends in Plant Science* discusses how we might understand how the forest may speak to us about where people have died. We discussed large inputs that would come from cadavers, such as nitrogen, that would fertilise the plants near a body.

The ways that plants respond to nitrogen influxes are well understood. Nitrogen causes plant leaves to become greener as plants make more chlorophyll. In addition, there may be more nuanced signals – such as drugs or metals – that would leach from dead bodies into the soil.

Certainly, these soil inputs would change microbes near roots, which in turn alters the nutrients plants absorb via their roots.

My colleagues and I quickly came to the conclusion that we didn't really understand the full picture of how trees and shrubs may change their chemistry, biology and physical appearance in response to cadavers.

But one thing our multidisciplinary team did know is that we had the perfect place to find the answers to these questions – the Body Farm. We had also been flying small drones with sensors to study how an agricultural plant – switchgrass – responded to nitrogen inputs (a paper on that work is under review). So, we had some ideas about how drones might be used to detect cadavers.

You might wonder how my colleagues and I can distinguish between a plant's response to a dead animal versus a human cadaver. Because most wild mammals are much smaller than humans, the plant response to a dead animal versus a dead human should create signals that blend in as background noise. Deer might be an issue since they can weigh as much as a human.

Beyond dead bodies, my lab has genetically engineered plants to sense and report problems, such as plant diseases, including those that are caused by bacterial pathogens and ionizing radiation. Our engineered plants produced fluorescent proteins upon sensing a particular signal, such as a pathogen or radiation exposure. And we recently custom-made a "fluorescence inducing laser projector" to take images of plant fluorescence signatures in the lab.

So, while we don't exactly know how plants may tell us where dead people are, we started learning in June of this year by using the multidisciplinary resources available to us. At some time in the next two years we hope to have a much better understanding of what trees and shrubs have to tell us about missing people, and learn how to "hear" them from the air.

The writer is professor of plant sciences, University of Tennessee, US. This article first appeared on www.theconversation.com

PLUS POINTS

Cyber shield

A team of researchers from the Indian Institute of Technology-Guwahati, in collaboration with scientists from the University of Pardubice, Czech Republic, is working towards developing indigenous algorithms that can protect the nation's digital data from cyber attacks by advanced computers. The team has also designed encryption architectures that can be used to protect sensitive health data that is transmitted through the Internet.

The team led by Gaurav Trivedi, associate professor, department of electronics and electrical engineering, IIT-Guwahati, includes Srinivasan Krishnaswamy, assistant professor, department of electronics and electrical engineering, IIT-Guwahati, and Zdenek Nemec and Jan Pidanic from the University of Pardubice. The team also consists of research scholars Bikram Paul, Uddipana Dowerah, Tarun Kumar Yadav, Balbir Singh, Abhishek Agrawal, Meenali Janveja, and Souradip Pal from IIT-Guwahati. The team's work has been published in the proceedings of *IEEE International Conference Radioelektronika* (RADIOELEKTRONIKA).

The recent advances in computer science, such as the development of the quantum computer, are all set to overthrow Moore's law that has ruled the roost for the last half a century. The phenomenal computational power of quantum computers not only embodies possibilities of astronomical progress, but also enormous threats. For example, while sensitive data is stringently protected by encryption (the virtual "lock" for precious data), the power of quantum computers can easily break even apparently "invincible" encryption codes.

It has given rise to a new field of research, called Post-Quantum Cryptography and state-of-art research teams all over the world, such as the one at IIT-Guwahati, have been working on developing algorithms to secure data from attacks by advanced computers.

The team has developed various PQC-based encryption algorithms and designed indigenous soft IPs which can be integrated into Systems-on-Chip to protect them from cyber attacks. These algorithms and IPs would enable critical data such as national security data and citizen information to be under unbreakable lock-and-key, thereby enhancing the safety of our nation against cyber-attacks.

The IIT-Guwahati team has also worked towards enhancing data security in the healthcare sector that is increasingly using the Internet-of-Things to cater to the needs of the country. Iot healthcare aids in the real-time diagnosis of diseases by keeping a patient digitally connected to a medical expert 24x7, thus avoiding the visits and admissions in the hospital, a facility particularly critical in these pandemic times.

Bad news for superbugs

Researchers at the University of Sheffield in the UK have developed a new compound that is able to kill both gram-positive and gram-negative antibiotic-resistant bacteria.

Gram-positive and gram-negative bacteria have different cell wall structures, but the new antibiotic compound is able to pass through the cell wall of both forms and then bind to the DNA. The findings, published in *Chemical Science*, pave the way for developing new treatments for all kinds of antibiotic resistant bacteria, including the gram-positive MRSA and gram-negative E Coli.

The team from the University of Sheffield has previously developed new compound leads that specifically target gram-negative bacteria, but this new compound is a broad-spectrum antimicrobial which means it is just as effective in both types of bacteria. Gram-negative bacteria strains are particularly difficult to treat as their cell wall prevents drugs from getting into the microbe, they can cause infections including pneumonia, urinary tract infections and bloodstream infections.

The team worked with colleagues at the Science and Technology Facilities Council's Rutherford Appleton Laboratory. Professor Jim Thomas, principal investigator of the research from the University of Sheffield, said, "Antimicrobial resistance is an increasing problem with many studies predicting a medical global emergency, so broad-spectrum antimicrobials which work against resistant pathogens are urgently needed.

"As the compound is luminescent it glows when exposed to light. This means we were able to follow the uptake and effect on bacteria using advanced microscopy techniques available at STFC's Rutherford Appleton Lab."

Doctors have not had a new treatment for gram-negative bacteria in the last 50 years, and no potential drugs have entered clinical trials since 2010.