Hunting at night

The early night owl was a dinosaur

S ANANTHANARAYANAN

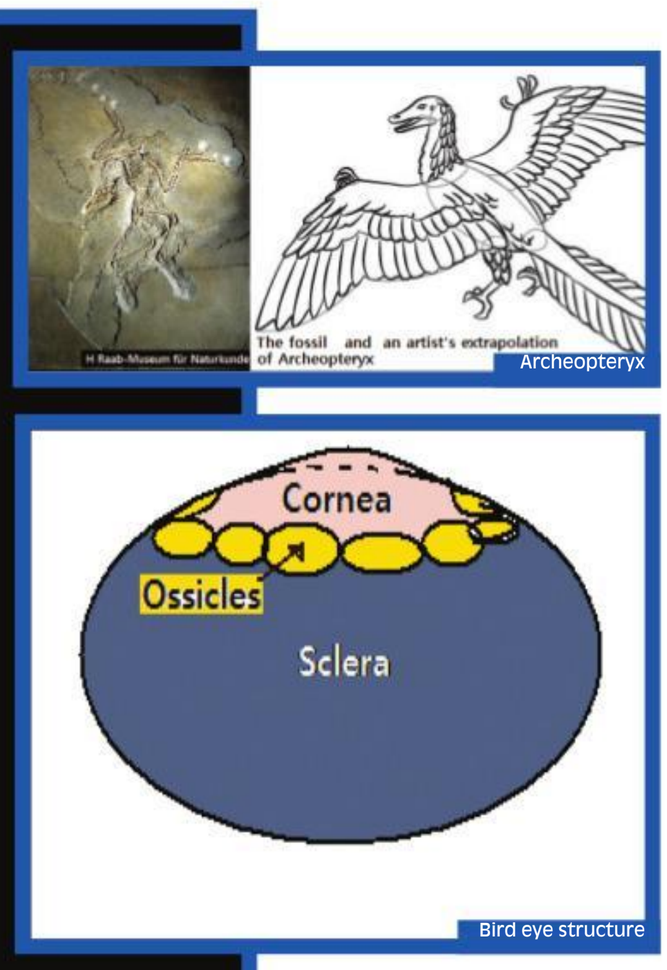
Birds are essentially daylight creatures, but there are some that have adapted to hunt in the night. And night birds have evolved very acute visual and auditory sensitivity. As birds are known to have evolved from dinosaurs, a valid question is whether this ability to hunt in poor light existed among dinosaurs too.

Jonah N Choiniere, James M Neenan, Lars Schmitz, David P Ford, Kimberley E J Chapelle, Amy M Balanoff, Justin S Sipla, Justin A Georgi, Stig A Walsh, Mark A Norell, Xing Xu, James M Clark, Roger B J Benson, from University of the Witwatersrand, South Africa, Universities of Oxford, Edinburgh and Iowa, John Hopkins University, Midwestern University, George Washington University, Claremont McKenna, Scripps, and Pitzer Colleges, Claremont and Institutes and Museums in Los Angeles, New York, Edinburgh and Beijing, answer the question in the affirmative. In their paper in the American Association for th e Advancement of Science journal, *Science*, they identify a species of dinosaur, which lived in the Late Cretaceous epoch (100-66 million years ago) and had the same adaptation for poor light as present night birds.

Ancestors of the birds were a group of meat-eating dinosaurs called theropods, a bipedal group with hollow bones and three-toed feet. We usually associate dinosaurs with huge and fearsome creatures – and the largest dinosaurs belonged to the group of theropods. Theropods, however, were of all sizes, going down to less than a kilogram in weight, and it is from this group that some evolved into birds.

The Archaeopteryx, discovered in the 1860s, was a chicken-sized creature that had many features of dinosaurs, like jaws with sharp teeth, three fingers with claws and a long bony tail, but also had a pair of broad wings, that enabled it to glide or fly, as well as long, powerful front limbs. The Archaeopteryx was hence considered the transition, or the bridge, between reptiles and birds. More specimens of feathered dinosaurs, however, have been discovered, and there are now more candidates for the beginning of the evolutionary tree of birds.


Barn owl



Birds have specialised – according to conditions, available prey or sources of food, and predators – and there are now some 10,000 different species. And as mentioned earlier, the majority are birds that hunt or forage in daylight. There are, however, a few species, mainly different kinds of owls, the nightjar, frogmouth, night heron, which have specialised for hunting in the dark or low light.

The authors of the paper note that this adaptation is in the form of large pupils of the eyes, to increase sensitivity to light, and again in the features of the ear, to detect feeble sounds – most marked in the barn owl, which can hunt in total darkness. These adaptations result in skeletal structure to accommodate the larger eyeball, in the case of vision, and the longer organ called the lagena, in birds, or the cochlea, in mammals, of the inner ear, that processes sound in the case of hearing.

"Most nocturnal birds have conspicuous modifications of the visual system, and specialised nocturnal foragers of active prey combine adaptations of both vision and hearing," the paper says. Although such features of the skeletal structure should be evident in fossils, whether and how night hunting in birds evolved from their dinosaur ancestors, or even the biology of dinosaurs, is not well understood, the paper says.

The authors of the paper hence undertook a survey of the dimensions of the eye cavity and the inner ear of nearly a hundred living birds and extinct dinosaurs (using fossil records in the case of dinosaurs). In respect of vision, the anatomical feature studied was the scleral ossicle ring, or the bony casing as part of the sclera, the container, the outer layer of the eye, a feature seen in birds and in many vertebrates. And in respect of hearing, the cochlea, the spiral-shaped, bony, resonating cavity, lined with sound-sensing filaments, to pick up different frequencies.

The eyes of birds that hunt in low light are highly adapted to suit the purpose. Unlike the eyes of mammals, their eyes are not round but tubular, and packed with rods, as opposed to cones, for greater sensitivity. And they have no eyeball that can move – instead, the large vision apparatus is rigidly fixed to the bony, ossicle ring. The bird hence has to turn its head to change its gaze. The eyes, however, are larger, in case of the owl and they account for three per cent of body weight – a thousand times more than ours – and are therefore highly adapted to see in great detail and in poor light.

As for hearing, the study of 88 species of living birds, the paper says, shows that birds that hunt in the dark all have elongated or highly elongated cochlear ducts, as opposed to daytime birds. "This suggests that duct elongation is an adaptation for auditory foraging, contradicting the hypothesis that it evolved to facilitate intraspecific communication," the paper says. Woodpeckers, which use sounds to track concealed insects, also show limited-moderate duct elongation, the paper says.

The question now is whether such adaptations for low light foraging can be seen among dinosaurs. The paper reports that adaptation to night hunting is there in a group of small dinosaurs that existed from the Jurassic, which is the epoch just before the Cretaceous (100-66 million years ago), and through the Cretaceous. Computer-based reconstruction of the casing of the eyes show large eyes and openings, suggesting adaptation for night hunting in the case of two groups. The first, an early group, retains much of the general features and may not have specialised its manner of hunting. The other, called *Shuvunia Deserti*, which appears in the Late Cretaceous, developed a bird-like skull and limbs and digits suited for scratching and digging.

The hearing apparatus was studied using micro-CT scans. It is found that *Shuvunia* has an elongated cochlear duct, with a large curved diameter, similar to that of the current barn owl. While such hearing adaptation is seen in the theropods, the elongation is exceptional in the case of *Shuvunia* and one more, the paper says, in a manner comparable to how the elongation in the barn owl is not even seen in other owls.

The paper notes that acute hearing ability, while exceptional among birds, is not so rare among dinosaurs and is fairly common among mammals that hunt at night. The paper surveys the occurrence of both visual and hearing acuity, other features, like modification of dental endowment and limbs suited for digging and scraping, to expand our understanding of ancient ecosystems and how specialisation for hunting at night took place, independently among birds and mammals.

The writer can be contacted at response@simplescience.in

PLUS POINTS

Bamboo bats

Cricket bats made of bamboo instead of the traditionally used willow are stronger, offer a better "sweet spot," and deliver more energy to the ball on impact, according to a new study.

Using techniques such as microscopic analysis, video capture technology, computer modelling, and mechanical testing, scientists at the University of Cambridge found that bats made of bamboo enabled "increased energy transfer from the player to the ball," than willow which has become synonymous with cricket bats.

The results of their analysis, published in the Journal of Sports Engineering and Technology, noted that their specially made prototype laminated bamboo bat is significantly stronger than willow blades and can hold much higher loads.

Since bats made with bamboo could be thinner while remaining as strong as willow, the researchers believe batters can swing the lighter blades significantly faster to transfer more energy to the ball.

Scientists also found that their prototype's "sweet spot" – the area on cricket bats where energy transference is at its most efficient – performed 19 per cent better than on a traditional willow bat.

"This sweet-spot was about 20 mm wide and 40 mm long, significantly larger than on a typical willow bat, and better still, was positioned closer to the toe (12.5 cm from the toe at its sweetest point)," the researchers noted in a statement. Players using bamboo bats would also not feel any more vibration than they faced off a willow bat's handle.

They believe blades made of bamboo can also be a sustainable option for the future. Citing previous studies, the scientists said there is already a shortage of good-quality willow since these trees, which grow mostly in England, take up to 15 years to mature to a point where the wood can be used to make bats.

Using willows to make cricket bats also posed the problem of increased wastage as manufacturers throw away nearly a third of the timber they source.

In contrast, the researchers said the bamboo varieties suitable for cricket bats grow abundantly in China, across South-east Asia as well as South America, and mature twice as fast as willow.

The cell structure in the laminated bamboo material is more regular, according to the scientists, potentially leading to less wastage of raw material during manufacture. They say its low-cost production and increased sustainability can make bamboo cricket bats a viable and ethical alternative to willow.

–THE INDEPENDENT

For the brain

A team at the Indian Institute of Technology-Mandi have invented a method to simultaneously study the variations in nerve functions and brain blood flow associated with brain disorders such as Ischemic stroke. The invented method helps in locating and classifying damaged sites (lesions) in the brain, brought about, or leading to neurological diseases.

Results of the study led by Shubhajit Roy Chowdhury, associate professor, School of Computing & Electrical Engineering, IIT-Mandi, has been published in IEEE Journal of Translational Engineering in Health and Medicine and the team has been recently granted a US patent for the invention. Roy Chowdhury has collaborated with Abhijit Das, a neurologist from the Institute of Neurosciences, Kolkata, and Anirban Dutta, assistant professor in restorative neurorehabilitation from the department of biomedical engineering, University at Buffalo, US.

A benign electrical current is given to the brain through electrodes, and the responses of the brain in terms of nerve action and blood flow are simultaneously measured by electroencephalography and near-infrared spectroscopy. While EEG and Nirs are already used independently, the prototype developed by IIT-Mandi innovators combines them into a single point-of-care unit to get a more accurate picture of the Neurovascular coupling.

DELVING INTO PREGNANCY LOSS

What causes miscarriages? An expert explains why women shouldn't blame themselves

ROCHANDA MITCHELL

Mother's Day is a happy day for millions, but for those who have experienced a miscarriage, the day can be devastating. As many as one in four recognised pregnancies result in miscarriage.

Pregnancy loss can be mentally and physically taxing. Women often have feelings of sadness, anger, isolation and guilt. Often, women blame themselves for the loss, which may lead to feelings of hopelessness and depression.

I am a fellow in maternal-foetal medicine, and I have seen first-hand the emotional upheaval that many women experience after miscarriage. Caregivers and loved ones can help by understanding a woman's feelings and helping her know that this loss was not her fault. I know that having honest dialogue about the incidence and cause of early pregnancy loss may foster a community of support and make the topic of pregnancy loss less taboo.

Why it's not the woman's fault

About 15-25 per cent of all clinically recognised pregnancies result in pregnancy loss. Some miscarriages occur before a woman is aware, thus accounting for the wide variation in the incidence of pregnancy loss.

About 80 per cent of all pregnancy losses occur within the first trimester and are often caused by having missing or extra chromosomes, called aneuploidy. Sporadic errors during chromosomal division and duplication cause aneuploidy. Many of the abnormal chromosomes are incompatible with life and result in miscarriage. These genetic errors are considered sporadic because they're due to chance and weren't passed down as an inheritable trait from the parents.

When an extra chromosome occurs, the result is called trisomy. The most common chromosomal abnormality found in first trimester loss is trisomy 16. The term trisomy 16 indicates that there are three copies of chromosome 16, instead of the normal two copies of the chromosome. This almost always results in pregnancy loss.

About five per cent of women will experience two consecutive pregnancy losses, and one per cent will experience three or more consecutive pregnancy losses. Consecutive pregnancy loss is known as recurrent pregnancy loss. Women who experience this should discuss it with their obstetrician/gynaecologist and schedule a clinical workup.

What doctors know about pregnancy loss

The cause of pregnancy loss is often beyond a woman's control. It can be related to genetics, abnormalities in the uterus, autoimmunity, infections and metabolic disorders. Lifestyle choices, such as avoiding tobacco and drugs, are a few of the things that can lower the risk of miscarriage.

Miscarriages caused by uterine abnormalities happen most often in the second trimester. Something called a septate uterus is the most common of the malformations, occurring when a fibrous or muscular membrane, or septum, develops inside of the uterus and divides it. This typically happened when the woman herself was a developing foetus in her own mother's womb. Unless it has been diagnosed by a doctor, a woman would not even know she has this condition.

Septate uterus can be surgically corrected and improve pregnancy outcomes, but there are no known surgical corrective options for other types of abnormalities.

Clotting disorders and lifestyle

A clotting disorder known as antiphospholipid syndrome is also associated with pregnancy loss. This condition causes the placenta to develop and implant abnormally. About five to 20 per cent of patients with recurrent pregnancy loss will be positive for antiphospholipid antibodies, but women are not routinely screened for this condition. If a woman has a history of recurrent pregnancy loss, however, she and her physician should consider testing for this syndrome. Treatment with low-dose aspirin and heparin has been shown to improve live-born rate.

Women can and should do everything they can to take good care of themselves, pregnant or not. When pregnant, however, it is especially important to manage chronic diseases such as diabetes. Also, doctors who treat pregnant women who smoke, drink alcohol or use other drugs can and should help them get treatment to help them stop. Ceasing the use of tobacco, alcohol and other substances has been associated with a decreased risk of miscarriage.

Grief and guilt abound

There is often a grief response associated with pregnancy loss. The psychological burden of miscarriage may negatively affect a couple's relationship. Increased awareness and sensitivity to the issues associated with pregnancy loss are essential to eliminating the stigma some women experience. And, many women feel guilty when they experience a miscarriage, which may compound the grief.

Having more open dialogue regarding pregnancy loss may reveal just how common miscarriage is. Fostering a community of support is important in helping women move through this difficult process. During this Mother's Day celebration, let us celebrate mothers with living children and honour those who have had the unfortunate experience of pregnancy loss.

The writer is a fellow in maternal-foetal medicine, University of Virginia, United States. This article first appeared on www.theconversation.com