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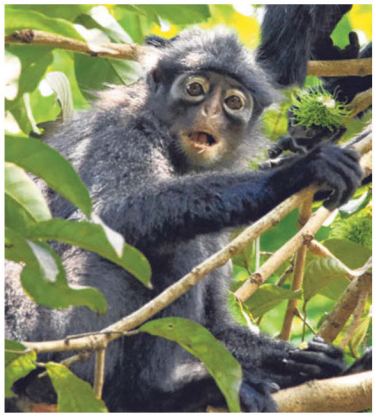
Researchers from the National University of Singapore and Berlin's Natural History Museum in Germany found that the genetic material of the critically endangered Sunda pangolin (left) and Raffles' banded langur (below) can be detected in fly excreta.
PHOTOS: LIANHE ZAOBAO, SABRINA JABBAR

Researchers use fly faeces to get insight into S'pore's biodiversity



Scientists' findings pave way for low-cost, non-invasive method of surveying wildlife

Ang Qing

Most people detest flies, so their faecal matter and vomit would be even more unappealing.

But a group of scientists have found that there is value in the waste of certain faeces and flesh-eating flies.

Researchers from the National University of Singapore (NUS) and Berlin's Natural History Museum in Germany have found that the genetic material of the critically endangered Sunda pangolin and Raffles' banded langur can be detected in fly excreta.

This paves the way for a low-cost, non-invasive way of surveying the diversity of wildlife in nature areas.

Their method, used in a study whose report was published on online archive bioRxiv last month, recorded 20 species of animals, including birds and reptiles, in the Nee Soon swamp forest using DNA signals found in the excreta of about 400 flies.

Currently, the analysis of invertebrate-derived DNA (iDNA) – vertebrate DNA that is sourced from invertebrates (with no backbone), including mosquitoes and leeches – is used mainly to monitor mammals.

Biologist Rudolf Meier, who co-authored the study, said: "The advantage of flies is that they respond to any carcass and any dung that is nutritious. It could be a lizard dying behind some tree and flies will still be interested."

But the traditional method of extracting DNA from the guts of flies is often an expensive, time-consuming process that involves dissecting each specimen, he noted.

"For me, biodiversity surveys have to use techniques that can be done by many people at low cost, because otherwise you cannot gather enough information," said Professor Meier, who heads the Centre for Integrative Biodiversity Discovery at Berlin's Natural History Museum.

So the scientists turned to fly faeces and food that they regurgitate.

The researchers trialled a simplified technique, which gets the flies to naturally excrete their digestive fluids before dissolving the excreta in water and sequencing its DNA.

Their study found that nanopore DNA sequencing, a technique that can be used in a field station to get genetic information in real time, can reduce the time needed to obtain data if the target species can be matched with publicly available databases.

During their survey of Singapore's largest swamp forest in Nee Soon between May and July, the researchers also discovered that collecting flies near a road yielded similar results to collecting insects from deeper in the forest.

Eighteen of the 20 vertebrate species found, including threatened or endangered animals, could be detected within 150m of Old Upper Thomson Road near the forest remnant.

Ms Rebecca Loh, a research associate at NUS' Reproductive Evolution Lab, said: "It was quite surprising to know that just by collecting flies beside the road, you can already detect a lot of the vertebrate diversity in the forest.

"This has implications for future studies as it means that researchers do not need to go farther in the forest to collect flies, making it less invasive."

She helped sequence DNA for the study, along with Dr Amrita Srivathsan, a researcher at the Berlin museum who led and wrote the study.

The technique might be more efficient than camera-trapping as it can detect both arboreal (found in trees) and terrestrial animals from the ground, and also fast-moving and small-bodied mammal species that might not be picked up by camera traps, said World Wide Fund for Nature (Singapore) senior programme executive Elliott James Ong.

The NUS environmental graduate had compared the novel fly iDNA technique with arboreal camera-trapping for his final-year project and wound up losing one camera trap to a monkey.

"It was very tedious to set up arboreal camera traps because you need to climb up a tree to set them up and pray that they don't get wrecked.

"For the iDNA method, if you have a lab that can process the excretions, it can save more time than such traditional methods," he said.

More detailed research is needed on how far different kinds of flies travel in Singapore and how they interact with the surrounding area, said Prof Meier.

For instance, the study notes that carrion flies can move a distance of between 100m and 2,400m, which could explain how one fly contained a DNA signal from a kangaroo that was likely living in the Singapore Zoo in Mandai.

Still, the researchers' simplified iDNA protocol has attracted global attention.

Dr Marcio Pie, a senior lecturer in ecology at Edge Hill University in Britain, plans to use the method for his fieldwork in November in the Akamas peninsula in Cyprus.

Home to native creatures such as the Cypriot hare and Cypriot mouse, the area's high diversity, unique species, and the availability of traditional surveys in the region make it ideal for testing the iDNA fly technique, the Brazilian noted.

"Nowadays, the cost of field expeditions is often considerably higher than the cost of sequencing. Approaches such as (this new technique) have the potential of greatly reducing costs by allowing for the rapid accumulation of data on many species in a short period of time, at a scale that would be impossible with traditional methods," Dr Pie said.

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