News in focus

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Waterholes visited by the endangered Gouldian finch contained trace DNA that allowed scientists to detect the bird's presence.

RARE BIRD'S DETECTION HIGHLIGHTS PROMISE OF 'ENVIRONMENTAL DNA'

Researchers are increasingly using traces of genetic material in soil, water or ice to track rare and endangered species.

By Dyani Lewis

DNA gathered from remote waterholes in northern Australia has been used to detect a rare bird in the wild[1] for the first time. The result is the latest milestone in the rapidly maturing science of environmental DNA, in which traces of genetic material from soil, water or ice are used to reveal the presence of plants and animals.

In a study published on 14 November, a team in Australia reports that genetic material collected from waterholes showed that Gouldian finches (*Erythrura gouldiae*) had visited them in the previous 48 hours. Rangers also confirmed the species' presence at the locations.

Scientists have been using environmental DNA (eDNA) analysis for about 15 years, for purposes including tracking rare or elusive aquatic species, such as the great crested newt (*Triturus cristatus*) in the United Kingdom[2]. And in the past few years, the technique has increasingly been used to identify mammals, insects – and now birds – that live on land.

Testing for eDNA is often safer – for both animals and researchers – more cost-effective and, in some cases, more accurate and sensitive than conventional methods used to pinpoint rare and endangered species, scientists say. This is prompting regulatory agencies in a number of countries to adopt the technology to locate creatures, such as the endangered Canada lynx (*Lynx canadensis*) in the United States, or to monitor for invasive species.

But the technique is yet to convince some scientists, who say eDNA results aren't robust enough to be used as the sole basis for making environment-management decisions that can have legal implications for governments and land owners.

Early studies that used eDNA to pinpoint specific species were criticized because of the potential for improper handling of samples to cause cross-contamination, leading to false-positive results. Scientists using the method are detecting only trace amounts of genetic material, so even minute amounts of contamination can taint the results. But proponents of the field say that the recent adoption of rigorous protocols that avoid or detect contamination have largely addressed such issues.

The first study to show that large-bodied animals and plants drop enough DNA into their environment — through defecation and shedding cells — to be detected[3] was published in 2003. Five years later, another team showed that DNA in pond water could be used to detect the invasive American bullfrog (*Rana catesbeiana*)[4]. Most such studies gather genetic material from aquatic environments because DNA disperses and remains free-floating in water, and can be detected in trace amounts.

Massive time savings

Around 2014, Michael Schwartz, who heads up the US Forest Service's National Genomics Center for Wildlife and Fish Conservation in Missoula, Montana, and his team used eDNA to detect the endangered and hard-to-monitor bull trout (*Salvelinus confluentus*). The researchers initially analysed 124 water samples from waterways across Montana[5], amassing a volume of data equivalent to that collected over the previous 15 years through conventional surveys that used electrofishing, a method that is risky for people and fish, in which a current is run through the water to attract and then net fish. "We were able to do that in eight days," Schwartz says. "We have estimated that it is about two to ten times faster and two to five times more cost-effective to use eDNA compared to electrofishing."

Earlier this year, Schwartz's team published results showing that DNA left in snow tracks or in snow near camera traps could be used to identify the presence of Canada lynx and wolverine (*Gulo gulo*) in Montana, and a small carnivorous mammal called the fisher (*Pekania pennanti*) in Idaho[6]. Conventional methods for detecting the presence of land animals typically involve time-consuming surveys to identify an animal by its tracks alone, or from scat.

In another case, eDNA was more sensitive than conventional methods. When a camera trap image was unable to clearly identify what looked to be a Canada lynx in an area where its presence was unknown to rangers, eDNA extracted from the snow confirmed that the creature was indeed a lynx, says Schwartz.

In some cases, eDNA analyses are being used to enforce policy. In 2014, the UK government approved the use of eDNA analysis for detecting the endangered great crested newt in land-use surveys that are required by law.

With a burgeoning market for eDNA analyses, dozens of companies now offer genetic tests for detecting rare species.

To reduce problems such as false positives that plagued the field in its early days, there are now standard methods for handling samples and detecting contamination, says Florian Leese, an aquatic ecologist at the University of Duisburg–Essen in Germany. Adequate sampling, sterile equipment and experimental controls can all help to guard against contamination. DNAqua-Net, a European-based network of researchers who work with industry bodies and regulatory agencies, is developing best-practice guidelines on how to design and validate tests for individual species and to define the amount of DNA needed to be sure a test returns a genuine positive result.

KONRAD WOTHE/NPL

DNA from snow tracks allowed scientists to detect the presence of the Canada lynx.

But some ecologists are reluctant to abandon conventional methods. Jean-Marc Roussel, an aquatic ecologist at the French National Institute for Agricultural Research in Rennes, says that more studies comparing the cost and accuracy of eDNA analysis to conventional monitoring methods are needed before environment-management decisions are made on the basis of eDNA results.

Molecular ecologist Cecilia Villacorta Rath at James Cook University in Townsville, Australia, thinks researchers also need to demonstrate that genetic tests are sensitive and specific enough to avoid false negatives — the failure to detect a target species that is there.

Robust results are essential because the discovery of an endangered species can have weighty legal ramifications. In the United States, such species need to be protected under the Endangered Species Act, so an area could be designated a critical habitat as a result.

As the chair of DNAqua-Net, Leese is leading the charge to develop standards that ensure genetic tests are accurate and give agencies confidence in their results. The next step could be to certify companies and laboratories doing eDNA studies, he says.

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ITALIAN PLAN FOR NEW RESEARCH AGENCY DRAWS CRITICISM

Scientists say they haven't been consulted on the creation of another national science funder.

By Marta Paterlini

The Italian government is debating whether to set up a national research agency — an organization that could boost research funding by hundreds of millions of euros a year. But although scientists have long called for such an agency, some are concerned about the latest plans. They worry that researchers haven't been involved in discussions about the organization, and that it won't be independent of political influence.

Prime Minister Giuseppe Conte, who leads a coalition government of the populist Five Star Movement and the centre-left Democratic Party, mentioned the idea for a National Research Agency (ANR) in a September speech. The proposal will be discussed in parliament this month as part of Italy's 2020 budget bill.

Italy already has several mechanisms for funding basic science, but researchers complain that the system is haphazard, and that calls for grant proposals are often delayed. The country's existing National Research Programme has a budget of €2.5 billion (US$2.8 billion) for 2015–20. But

> **"The agency's function and governance can only be decided after a discussion with the research community."**