FRESHWATER HABITATS TRUST
News release

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Pioneering DNA technique offers hope for protection of endangered aquatic species

A groundbreaking new technique analysing DNA traces in water offers hope for the future protection of rare and endangered aquatic species – including Britain's population of great crested newts – by making it much easier to find them in the depths of ponds and streams.

In one of the world's first applications of the pioneering survey method, a Defra-funded research project has discovered that monitoring levels of environmental DNA (eDNA) in water is a remarkably accurate and rapid method for detecting the great crested newt.

The research – led by the Freshwater Habitats Trust with Amphibian and Reptile Conservation, University of Kent and genetics company SpyGen – is an important breakthrough.

The findings also bring potential benefits for developers who often have to provide planners with an accurate assessment of great crested newt populations on proposed development sites. The new method could reduce both the need for specialist surveyors and the amount of time traditionally taken on newt survey work, giving significant cost savings for developers.

The eDNA test is at least 10 times faster than traditional surveying methods, and surveyors can collect the necessary water samples quickly, easily and with only simple training. This means that many more sites can be checked for newts, and changes in their distribution across the whole country can be more easily measured – providing information that is essential for effective conservation and for land-use planning.

The findings are of wide significance for conservation, as eDNA could be useful for monitoring many other rare and endangered aquatic species – including freshwater fish, amphibians and invertebrates such as the rare pearl mussel, which are currently very hard to survey.

"Previously it has been impossible to determine whether the great crested newt population was going up or down because it was just too time-consuming and expensive to visit enough sites to get a reliable national or regional picture. Now that we've shown a single water sample can detect the newts with remarkable reliability, it makes large scale surveys practical – which will help enormously with future protection of Great Crested Newts," said Dr Jeremy Biggs, project leader and Director of Freshwater Habitats Trust.

Jim Foster, Conservation Director of Amphibian and Reptile Conservation, which runs the National Amphibian and Reptile Recording Scheme, said: "We hope that the new method will make it easier to understand the distribution of the elusive great crested newt. At some ponds our volunteers can spot newts very quickly using a torch or by searching for eggs. eDNA now means they'll be able to get reliable results from a wider range of ponds."

Under the new technique, traces of eDNA – which is released by plants and animals from their skin, faeces, mucous, hair, eggs and sperm, or when they die – can be used to monitor freshwater species living in a pond or stream through a simple water sample.

A 'primer' – an artificial length of DNA matching specifically the DNA of the species being surveyed – is first developed. Before trials began, the research team had to develop and test a primer for the great crested newt to ensure that it only detected this species.

Test kits with a simple instruction sheet were then mailed to 100 volunteers across the UK last summer. Without further training or requiring a survey licence, the volunteers collected and preserved a single water sample from a total of 250 ponds where great crested newts are known to occur, and posted the kit back for analysis. Laboratory testing showed that the eDNA techniques correctly detected newts in 91% of the ponds.

A more detailed study of 35 ponds in Hampshire and North Wales looked at how well the eDNA test detected newts over time. These intensive studies showed that a single water sample taken at any time during the newt breeding season of late April to June is almost certain to detect newts when present. DNA detected newts on 139 out of 140 occasions – a 99.3% success rate.

Both surveys were more effective than any combination of traditional methods for finding great crested newts, such as torch counting at night, bottle trapping or searching for eggs. Including time to get to and from the pond, it took volunteers only two hours to collect an eDNA sample. To detect newts with similar levels of certainty using traditional methods requires four night-time visits over a month by two people, taking up to 48 hours – 10 times longer.

The project team is now discussing the best way to deploy eDNA in volunteer and professional surveys whilst funding for sample analysis is finalised. Funding for the research project was by Defra, Natural England, Joint Nature Conservation Committee and Scottish Natural Heritage.

Notes to Editors

Publication date and time

The full report, "Analytical and methodological development for improved surveillance of the Great Crested Newt", will be published on Defra's website www.gov.uk/government/organisations/department-for-environment-food-rural-affairs on Friday 28 March 2014. Defra Press Office contact is Oliver Claydon [oliver.claydon@defra.gsi.gov.uk].

Project team

- Freshwater Habitats Trust is a national charity that works to protect life in freshwater. It undertakes research, policy and practical conservation work, like the Million Ponds Project, to protect and restore freshwater habitats, and the species that depend on these habitats. www.freshwaterhabitats.org.uk
- Amphibian and Reptile Conservation is a national wildlife charity committed to conserving amphibians and reptiles, and saving the disappearing habitats on which they depend. www.arc-trust.org
- Durrell Institute of Conservation and Ecology at the University of Kent is Britain's leading research and postgraduate training centre dedicated to conserving biodiversity and the ecological processes that support ecosystems and people. www.kent.ac.uk/dice
- Spygen is a spinoff technology company founded in 2011 by a team of molecular ecology scientists at the University of Grenoble, France, who pioneered the development of DNA barcoding for characterizing environmental biodiversity. www.spygen.fr

eDNA method

- Environmental DNA (eDNA) is nuclear or mitochondrial DNA released from an organism into the environment. In aquatic environments, eDNA is diluted and distributed in the water where it persists for 7–21 days, depending on conditions. Recent research shows that DNA of a range of aquatic organisms can be detected in water samples at very low concentrations using qPCR (quantitative Polymerase Chain Reaction) methods.
- Available evidence indicates that eDNA persists in water after being shed by an animal for up to one month. The research project found that ponds that gave a strong positive eDNA signal in summer were negative in winter when newts had left the pond.
- To compare effectiveness of eDNA with traditional newt survey methods (torch counting, bottle trapping, egg searches) the team visited 35 ponds in south Hampshire and north-east Wales four times, at 10 day to two week intervals, from late April to late June. On each visit newts were surveyed by torch counting, use of up to 60 bottle traps overnight, and searching for newt eggs; an eDNA sample was also collected. eDNA detected newts 99.3% of the time. Of the traditional methods, bottle trapping and torching were similarly effective, followed by egg searches, with the individual methods detecting newts respectively 76%, 75% and 44% of the time over the full survey period. When torch counting and bottle trapping were combined – normal practice, because individual methods on their own cannot be certain of detecting newts – the traditional method was only slightly less effective than eDNA. However, traditional methods take roughly 10 times longer to achieve the same result, and cannot easily be undertaken by volunteers on a large scale.
- The eDNA test is highly accurate at detecting whether newts are present, but currently does not provide reliable information on newt numbers. Sites with low eDNA scores always had low newt counts; sites with higher scores did not always have more newts.

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