European Commission

Science for Environment Policy

Environmental DNA in rivers can assess broad-scale biodiversity

Traces of animals' DNA in the environment, known as environmental DNA (eDNA), can be monitored to paint a picture of biodiversity, new research shows. This study used eDNA to assess biodiversity in an entire river catchment in Switzerland. Importantly, the eDNA technique allowed the researchers to detect both aquatic and land-based species in river water, making it possible to assess biodiversity over a broad scale.

Recently, eDNA analysis has emerged as a useful tool for conservation management. This technique identifies species in the environment through their DNA found in cells shed from skin, faeces or other bodily excretions. Much of the eDNA research to date has focused on identifying aquatic species. Suspended cells, particle bound or free-floating DNA in water can last from a few days to a few months and can be collected and analysed for the presence of genetic material, which is unique to a particular species or group of species.

In this study, researchers broadened the use of eDNA analysis to develop a picture of the biodiversity found in the Glatt river catchment in Switzerland. They collected water samples from eight sites along the river network where major sub-catchment tributaries join the main river Glatt and analysed these in the laboratory for specific gene sequences. Any DNA detected in samples from a particular site would suggest that the DNA came upstream from that site. The researchers also used the traditional kicknet sampling method to take water samples at each site. In this method, macroinvertebrates are collected in a net and visually identified onsite or in the laboratory.

In all, the eDNA analysis revealed the presence of 296 animal families in the Glatt river catchment. The researchers confirmed that all the families were recorded as being present in Switzerland or in the four neighbouring countries of Austria, France, Germany and Italy.

Most of the families identified (196) were arthropods (insects, crabs, spiders, millipedes). Significantly, 119 of the 255 species identified were terrestrial species which inhabit river banks or wet habitats or usually feed in aquatic habitats, but do not otherwise live or reproduce in the water. This suggests that DNA in river water can also be used to detect species in the surrounding landscape.

Of the 296 families identified by eDNA analysis, 65 are used as part of the Swiss biomonitoring programme. The kicknet samples revealed a further 13 macroinvertebrate families, not captured by the eDNA analysis. When comparing eDNA and kicknet methods for identification at each sampling site, the researchers detected 23–40 macroinvertebrate families through eDNA and 17–24 macroinvertebrate families through the traditional kicknet method.

Furthermore, the larger the overall size of the study area considered, the more families the eDNA analysis could identify. In comparison, the kicknet method did not detect this relationship. The researchers say that as rivers accumulate and transport DNA throughout the river network, they act as "conveyor belts of biodiversity information". eDNA analysis thus provides a powerful tool that can assess broad-scale biodiversity across a landscape.

Traditional methods and eDNA can also be used together, say the researchers. For example, combining the methods would work well in river restoration efforts by identifying areas where there is greater potential for recolonisation by lost species.

The study also highlights other benefits of eDNA analysis. For example, the method can detect the presence of species in a river habitat without the species being physically present at the time of sampling. Other studies[1] suggest eDNA can travel 12 kilometres in a river, making detection of rare or elusive species more possible. In addition, although not specifically evaluated in this study, the eDNA method typically uses less effort, time and expense than traditional sampling methods, which will help to reduce the cost of large-scale biomonitoring in river systems.

23 March 2017
Issue 485
Subscribe to free weekly News Alert

Source: Deiner, K., Fronhofer, E.A., Mächler, E., Walser, J-C. & Altermatt, F. (2016). Environmental DNA reveals that rivers are conveyer belts of biodiversity information. *Nature Communications*, 7:12544. DOI: 10.1038/ncomms12544. This study is free to view at: http://www.nature.com/articles/ncomms12544

Contact:
alpinedna@gmail.com or florian.altermatt@eawag.ch

Read more about:
Biodiversity, Biotechnology, Environmental technologies, Innovation and new technologies, Water

To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.

1. Deiner, K. & Altermatt, F. (2014). Transport Distance of Invertebrate Environmental DNA in a Natural River. *PLoS ONE*. 9(2): 88786. DOI:10.1371/journal.pone.0088786. This study is free to view at http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0088786