

AT A GLANCE

Environmental DNA

Environmental DNA (eDNA) refers to DNA obtained from an environmental sample, most usually water, soil or air. For larger species including humans, eDNA is recovered from fragments of cellular material shed into the environment, such as saliva, hair or skin cells. For microbes, whole organisms and their genomes may be captured. Acquisition of eDNA differs from traditional DNA analysis, where samples are taken directly from organisms.

Current applications and future opportunities

Rapid progress in eDNA research over the past decade has led to important developments in biodiversity monitoring, disease detection, and forensic science. Indeed, eDNA offers a wide range of applications, which are summarised in Figure 1. Future developments in eDNA technology may hold even greater potential. For example, advanced techniques may allow for more precise temporal and spatial localisation of DNA sources, aiding in missing person investigations and disaster victim identification. Air capture eDNA technology is also developing rapidly, with applications in biosecurity, agriculture, and forensics.

Why now?

As the volume of data and information that can be obtained using eDNA continues to increase, it is an important to consider how best to optimise the value of these technologies for both public and private sectors – and how to avoid harm. This document explores the wide-ranging applications and opportunities associated with eDNA, alongside the potential risks.

The UK is at the forefront of eDNA research and application, particularly in regulatory contexts, and there is an opportunity to build on this. Currently, eDNA is used to monitor protected species like the great crested newt, streamlining and cost-reducing conservation efforts. Additionally, via efforts such as the Darwin Tree of Life, the UK has the potential to become one of the first countries to create a comprehensive DNA reference library for its native species, a crucial resource for eDNA-based research.

Benefits and challenges

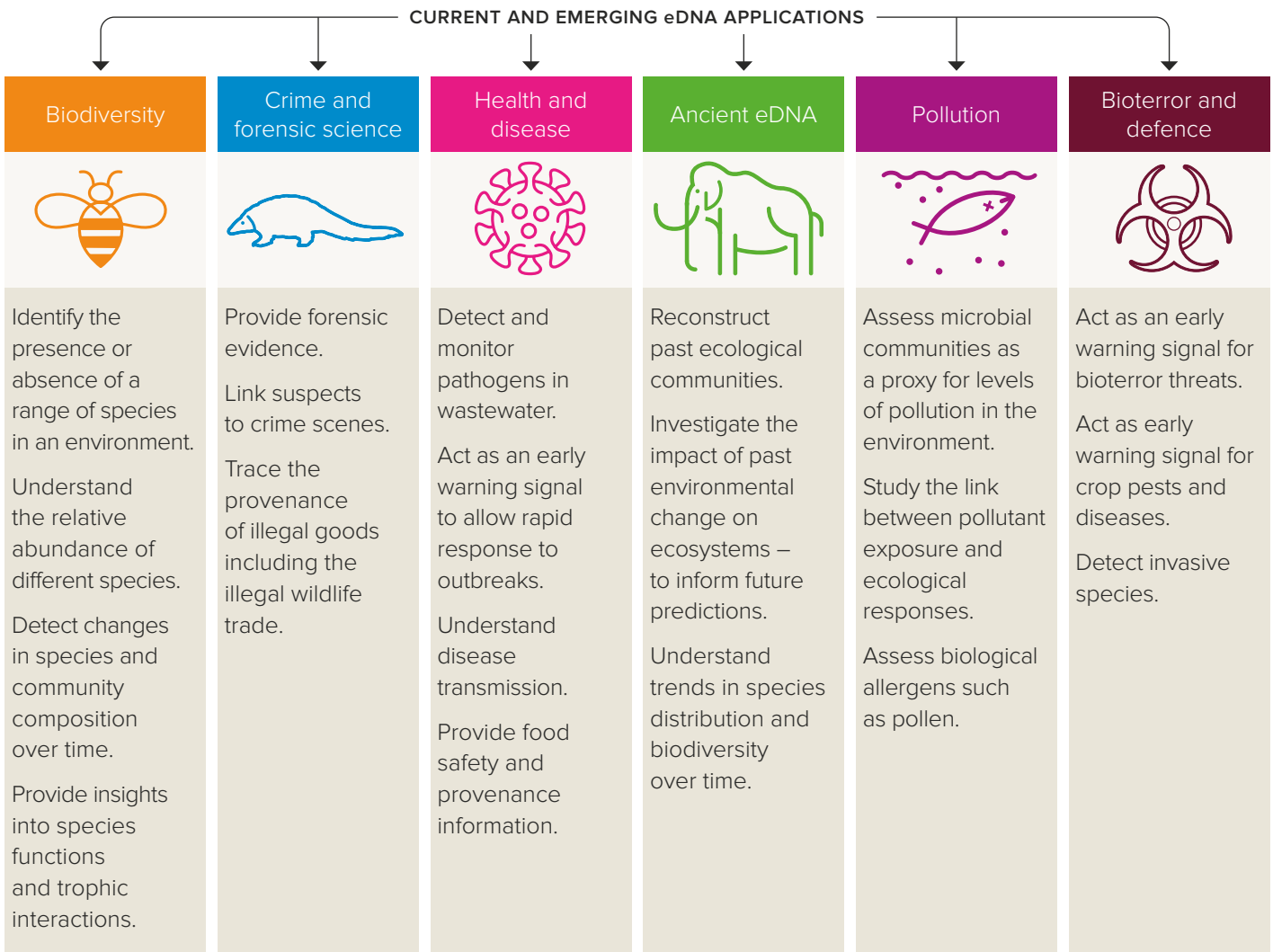
eDNA offers several advantages over traditional methods, including:

- **Insight**
It can provide richer and more comprehensive biodiversity data.
- **Efficiency**
It can be integrated into existing monitoring programs with minimal additional effort. Multi-purpose sampling and analysis may also make routine eDNA sampling particularly cost-effective.
- **Scale**
The efficiency of eDNA means samples can be taken over larger spatial areas and for longer timeframes than would previously have been practical.

However, the use of eDNA techniques can also pose ethical, legal, and regulatory challenges, especially when human DNA is involved. Issues of consent, privacy, and data security must be carefully addressed.

FIGURE 1

A summary of the current and emerging policy-relevant applications of eDNA



Key considerations for policymakers

To ensure that society and the UK benefit from the potential that eDNA technologies have to offer, and avoid harm, eDNA research would benefit from the following:

CONSIDERATION 1

Maximising the economic potential of eDNA technologies to both public and private sectors.

CONSIDERATION 2

Fostering interdisciplinary collaboration between researchers and practitioners to optimise eDNA research and applications.

CONSIDERATION 3

Investing in research infrastructure to support eDNA research, such as the development of reference libraries, data repositories, and standardisation tools.

CONSIDERATION 4

Addressing ethical and legal concerns by developing robust guidelines and regulations to mitigate risks associated with human DNA analysis.

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