Advantages and Shortcomings of the eDNA method

Dr Angeliki Savvantoglou

UWE Bristol University of the West of England

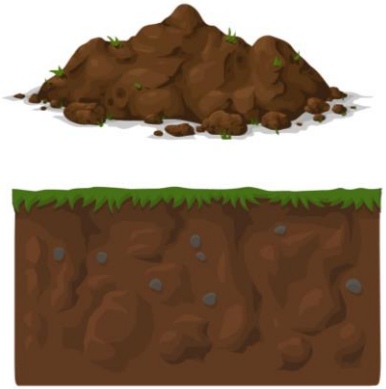
eDNA External DNA Research Group

Short introduction to eDNA methods

Looking for traces of target species' DNA in the environment

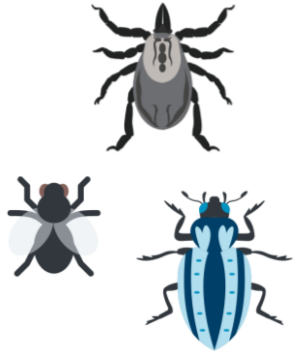
Environmental DNA can be found in:

Water



Surface soil and soil/sediment cores

Air and cavities



Invertebrates (iDNA)

Why eDNA?

General advantages of eDNA methods

- **Non-invasive**: The collection does not require contact with the animal, which makes it a lot more suitable for rare or elusive species.
- **Large coverage**: Some sample types have a large monitoring range, allowing us to cover challenging terrain and areas with no access.
- **Minimised surveyor bias**: Sample collection is not dependent on ID skills.
- **Survey-specific advantages / species-specific advantages**

eDNA methods: the technical part

Fieldwork

Sampling techniques vary across the different sample types, but they all have the following in common:

- **Low budget** field equipment can be used.
- **Minimal training** is required for sample collection.
- **Short fieldwork time** in comparison with other techniques.
- Samples are **preserved** until lab processing.

eDNA methods: the technical part

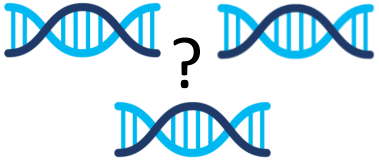
Lab work

Laboratory analysis depends on what we are looking for in our samples:

Single-species, or a small selection of known species

Species-specific or multiplexing

Species diversity in the sample



Metabarcoding

Species-specific versus metabarcoding

What are the benefits of each method?

Species-specific	Metabarcoding
More sensitive for rare species	Can miss rarer DNA in the sample
Analysis costs are low	Analysis costs are high
Less reliant on hi-spec equipment	Relies on highly trained lab techs and metabarcoding analysts

What can eDNA data tell us?

Using eDNA survey results to gather information on a species

eDNA gathers information on **species presence**.

Work is currently being done for most survey methods to define **what a 'detection' means**. How long has DNA persisted in the medium? How far has the DNA sample travelled? Does the amount of DNA in the sample equate with population size/activity patterns?

Positive detections can be used **for modelling the species' distribution** (MaxEnt)

For repeat surveys, data (positive and negative detections) can be used to run **occupancy modelling**.

Weaknesses of eDNA methods

eDNA methods are new and research is currently focusing on advancements and refinement of the different methods

- On single-species methods, the laboratory analysis needs to be adjusted to each species (primer/probe design), which **requires expertise**.
- eDNA samples **processing time** is long in comparison to direct results from other field survey methods.
- Any molecular lab work can be subject to **contamination**, often minimised by repeat sampling.

What my results showed

Advice from my personal experience with eDNA sampling

As we adopt eDNA on our monitoring efforts there are a few things that will **increase the reliability** of the results:

- **Repeat sampling** (sampling multiple times, over multiple seasons)
- **Repeat extractions** DNA of each sample
- **Amplification replicates** for each extracted sample

Repetition in these three survey stages will ensure the accuracy of the results and help us gather a vast amount of information for the species' ecology and habitat use.

Next steps with eDNA

eDNA has truly advanced species monitoring

Research is currently focusing on:

- Developing more eDNA **sampling techniques**
- Understanding what '**positive detection**' means for each method
- **Refining** the laboratory methods
- Designing **species-specific** methods for single-species detection
- Use of eDNA data in **spatial modelling**
- **Widening** the use of eDNA methods and **lowering** the processing costs

Thank you

Thank you to Dr Mark Steer, my PhD supervisor

Dr Angeliki Savvantoglou
xDNA Research Group
Centre for Research in Bioscience,
School of Applied Sciences,
University of the West of England
Email: angeliki.Savvantoglou@uwe.ac.uk