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# How can we detect rare animals?



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## Abstract

Did you know that scientists can use DNA to figure out which organisms have been in an area? Organisms leave DNA behind in the environment. We call this DNA environmental DNA (eDNA). Using eDNA is a new technique that scientists have used in water environments. We wanted to figure out if this same technique could work to find species on land.

We collected soil samples containing eDNA from golden moles in the western part of southern Africa. These mammals are hard to observe because they live underground and some species are rare. People believed that one species, De Winton's golden mole, might be extinct. We extracted eDNA from soil samples. Then we compared the eDNA to DNA samples we collected from golden moles and from databases. We found that all four golden mole species live in this region of Africa. That means that we can use eDNA to find rare animals in land environments. It also means that De Winton's golden mole is not extinct!

## Introduction

Scientists study **DNA** because it carries information about how an **organism** will live and function. Over time, DNA has become important in ecology. Ecologists are scientists who study the interactions between organisms and their environment. Ecologists are now using **environmental DNA (eDNA)** to study species. eDNA is DNA left behind in soil, water, or sediments. Organisms leave DNA in the environment as hair, fur, skin, urine, saliva, or blood. eDNA can tell scientists what organisms are in an area. It can also help scientists learn more about rare organisms that are difficult to observe in the environment.

Most ecologists who have used eDNA study ocean organisms. That's why we wanted to explore the use of eDNA to study land animals. Specifically, we wanted to use eDNA to find evidence of the golden mole. The golden mole is a species of **insectivore** that lives in southern Africa. They are very difficult to study and observe. That's because they burrow



**Figure 1:** We identified active mole sites using a trained scent-detection dog. **Photo**: Nicky Souness

in soft soils. There are four species of golden mole that live on the west coast of southern Africa:

- the Cape golden mole
- Grant's golden mole
- Van Zyl's golden mole – endangered
- De Winton's golden mole – critically endangered and believed to be extinct.

So, we used eDNA to determine where each species of golden mole can be found in this area of Africa.

## Methods

We collected 49 eDNA samples from sites in six regions along the west coast of South Africa. We collected soil samples from sites where there was golden mole activity. We identified active sites using a trained scent-detection dog (Fig. 1). We took soil samples from inside golden mole tunnels whenever possible.

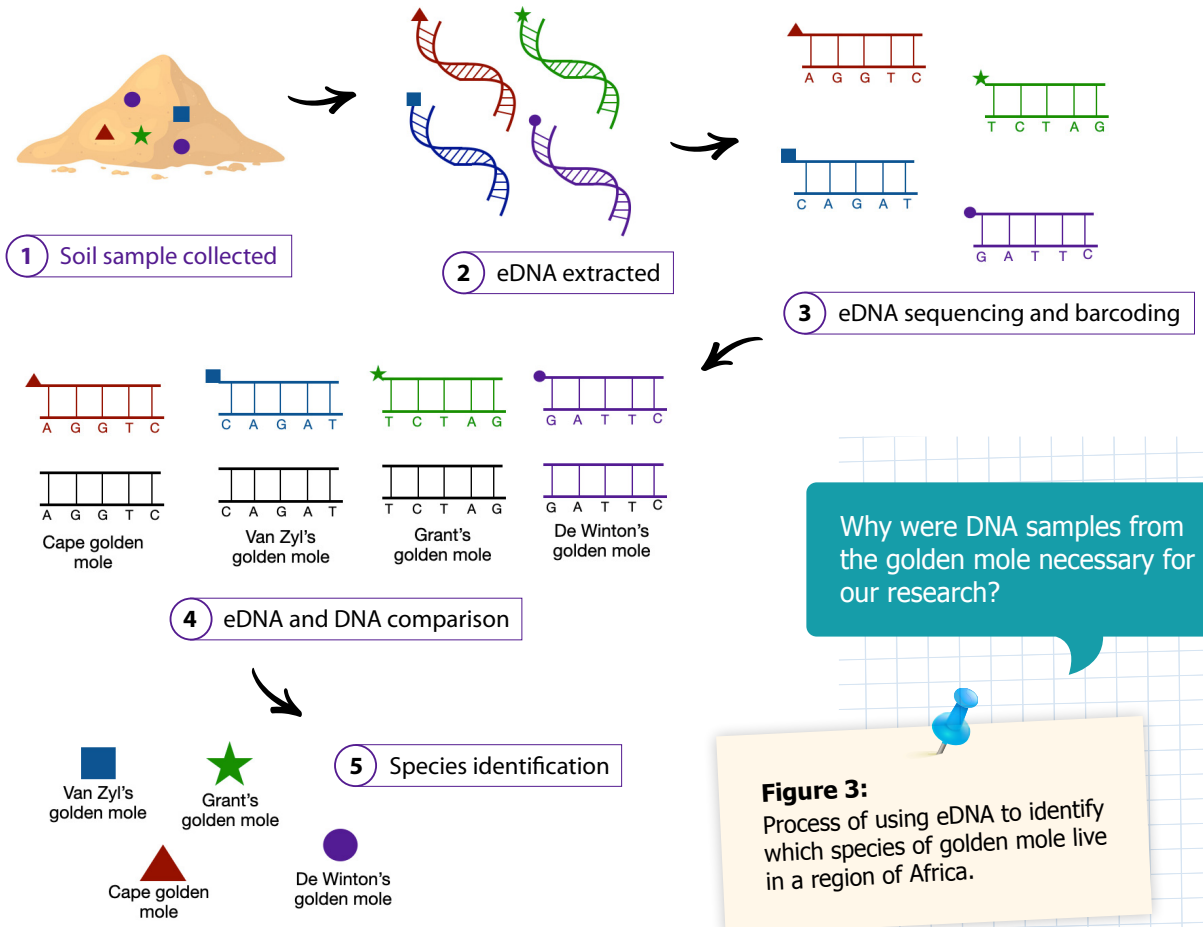
We also set up two **pitfall traps**. These traps are a safe way to capture a golden mole. We then collected DNA from the two moles that we trapped. We also collected DNA samples from the bodies of two golden moles that people's pets had accidentally killed.

In the laboratory, we **extracted** the eDNA from the soil samples and DNA from the golden mole samples (Fig. 2). Then we **sequenced** the eDNA and the DNA. That means we analyzed each one to determine its structure. There are four chemicals that make up DNA. We call them A, T, C, and G. These chemicals are like paper clips that link together in a chain. When we sequence DNA, we learn the order of the chemical links in the chain.

When we sequenced the DNA, we focused on three sections. That's because each animal species has a unique order of the DNA chemicals in these sections. These unique sequences are called a **DNA barcode**. Once we had sequenced the barcodes for the eDNA from the soil samples, we matched them with the DNA barcodes from the golden moles – like a shape-matching puzzle. (See Fig. 3 on the next page.) We also used golden mole DNA from a database to help us. When we found a match in a soil sample, we knew that a golden mole was in that region of Africa.



**Figure 2:**
We took the soil samples back to the lab to extract and sequence the eDNA.




Why were DNA samples from the golden mole necessary for our research?

**Figure 3:**
Process of using eDNA to identify which species of golden mole live in a region of Africa.

# Results

From our eDNA analysis, we found that all four golden mole species live along the west coast of southern Africa. We found Grant's golden mole and De Winton's golden mole in all six regions. In three of the regions, we found golden mole eDNA that could come from Van Zyl's golden mole. We also found evidence of the Cape golden mole in two of the regions.

# Discussion

Our results showed that eDNA techniques work in land environments. Plus, they can detect rare species! We now have evidence that De Winton's golden mole is not extinct. Instead, it is present in all the regions we investigated. We also found where the three other golden mole species are present.

Using eDNA in land environments will help with **conservation**. Golden mole populations are decreasing

because of human activity. Diamond mining is the main reason. To find diamonds, miners move sand dunes on the coast. This means less habitat for golden moles. Knowing where the golden moles live can help people protect them. But first, ecologists need to better estimate the number of golden moles in each region. They also need to find more details about where the golden moles live within that region. Then scientists and governments can work together to develop a plan to protect these species.

## Conclusion

Environmental DNA is a great reminder that everywhere we go, we always leave something behind. How can we make sure to leave as little behind as possible when we are outdoors? Follow the basic "leave no trace" principles. These include:

- properly disposing of your trash.
- keeping your distance from animals. Don't approach, chase, or feed them!
- leaving behind what you find. Instead of taking home a plant or rock, take a picture to capture the memory!

By respecting wildlife and their habitats, you can help conserve the species in your area and in places that you visit.

## Glossary of Key Terms

**Conservation** - the protection of animals, plants, and their habitat.

**DNA** - the material that carries information about how every living thing will look and function. It carries this information in the pattern of four chemicals: A, G, T, and C.

**DNA barcode** - a unique sequence of DNA chemicals found in specific sections of the DNA strand. Because it is unique, it can be used to identify an organism.

**Environmental DNA (eDNA)** - DNA left behind in the environment by an organism as hair, fur, skin, urine, saliva, or blood.

**Extract** - to remove the DNA from the nucleus or mitochondria of a cell.

**Insectivore** - an organism that mainly eats insects.

**Organism** - a living thing. Individual animals, plants, bacteria, viruses, and fungi are all organisms.

**Pitfall traps** - a safe capture device that consists of a container buried in the ground so that its top is level with the ground. Organisms fall into the container and cannot get out without assistance, but they are not harmed in the process.

**Sequence** - to determine the order of the DNA chemicals in extracted DNA.

## REFERENCES

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# Check your understanding

**1** How can we collect environmental DNA in a land environment?

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**2** Why did we also capture golden moles and take DNA samples?

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**3** How can scientists identify a species from eDNA?

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**4** Scientists think that eDNA will have additional uses in ecology. These uses include:

- calculating the number of species in an ecosystem,
- describing the migration patterns of a species,
- identifying changes in where a species lives in response to human activities or climate change, and
- monitoring the spread of non-native species.

With a partner, select one of these possible uses of eDNA and describe how eDNA can be used in this way. Then discuss why this information is important to collect.

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**5** Scientists expect the results of eDNA studies to inform conservation efforts. Research a threatened or endangered species that lives in your area. Then propose at least one way that your community could help conserve this species.

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