Using eDNA to Monitor Marine Biodiversity

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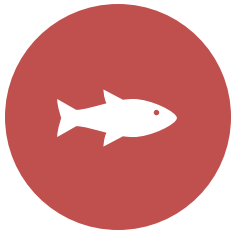
Why Monitor Marine Biodiversity?



Oceans support complex food webs

Many species are hard to observe directly

Traditional surveys are expensive and limited

Key question: How do we know what lives there?

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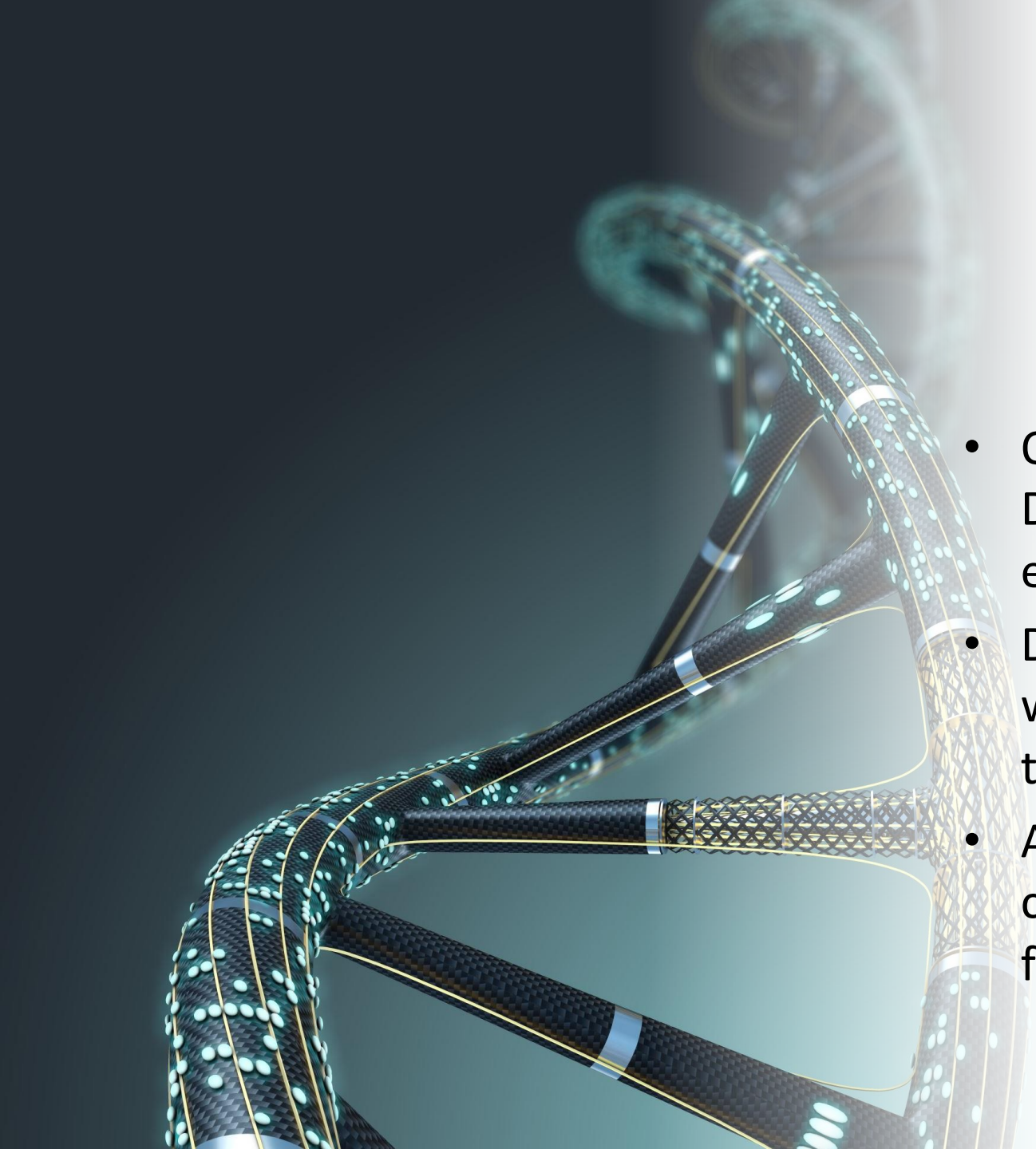

What is eDNA?

- Organisms shed DNA into the environment
- DNA persists in water as genetic traces
- A water sample can contain DNA from many species

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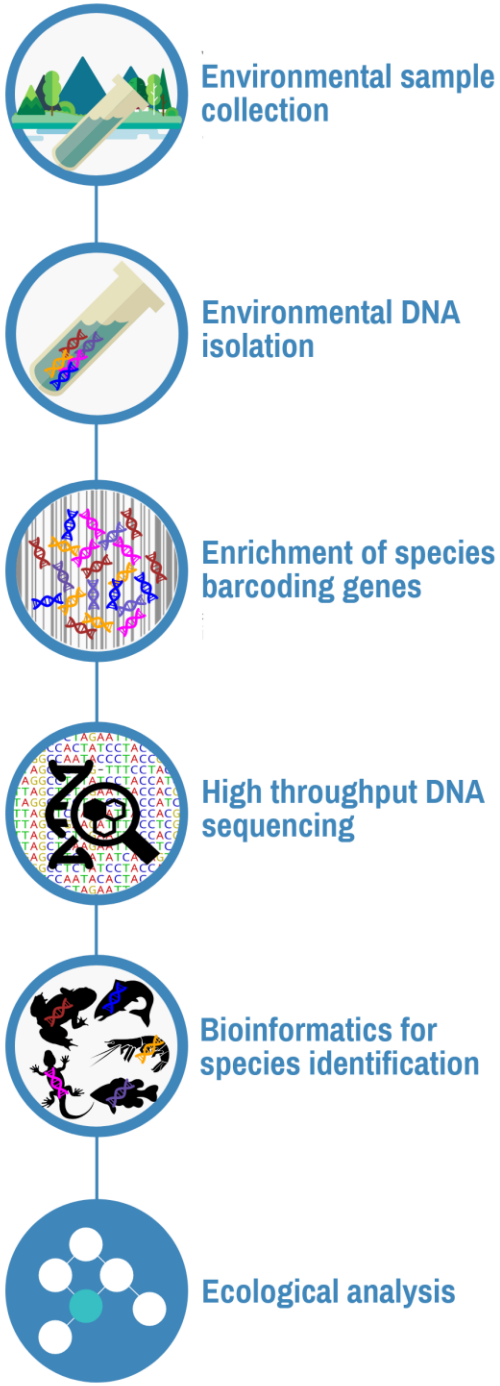

How Does eDNA Metabarcoding Work?

1. Collect water samples
2. Extract DNA
3. Amplify barcode genes
4. Sequence DNA
5. Match sequences to reference databases
6. Analyse patterns

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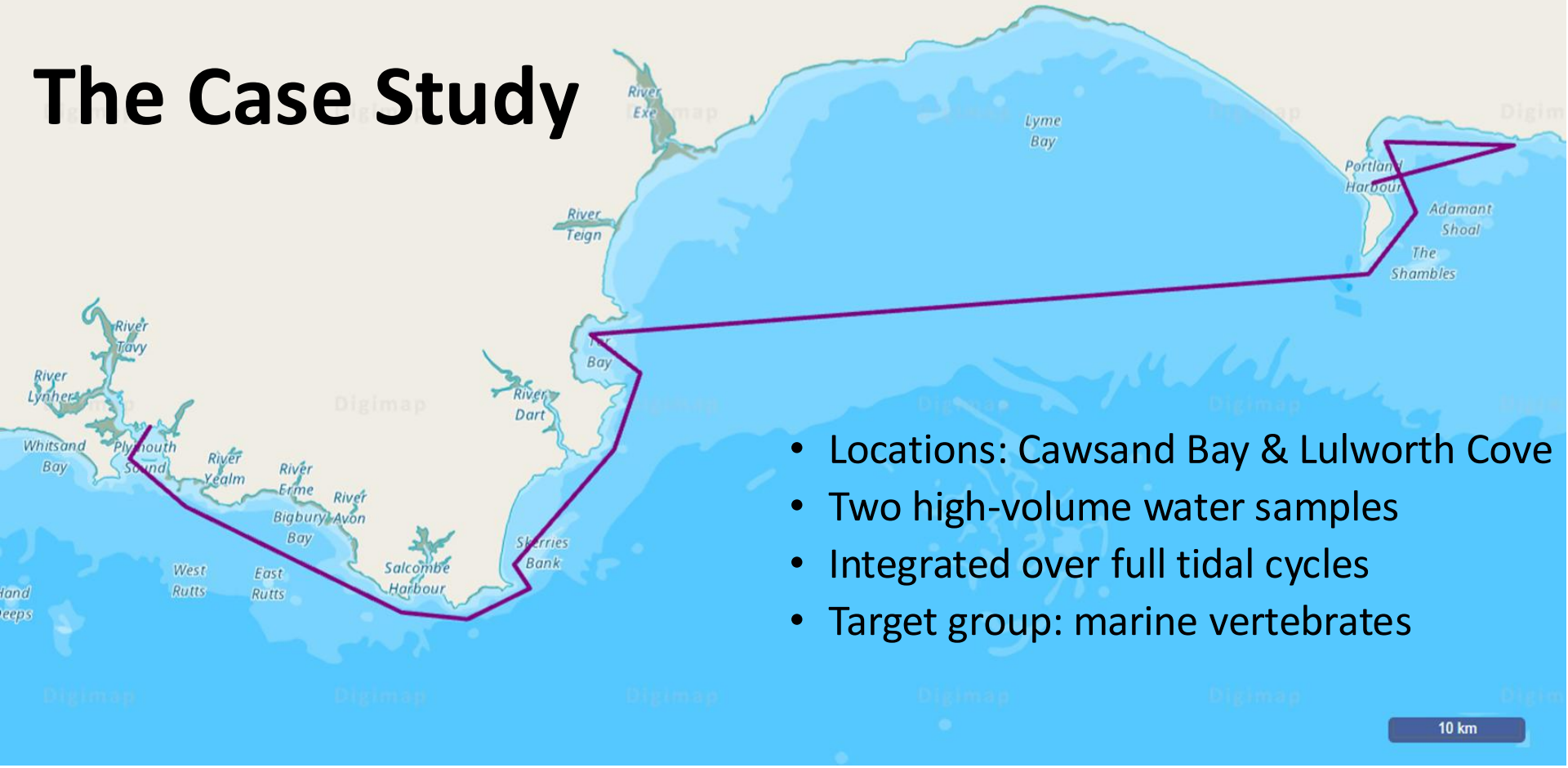
The Case Study



- Locations: Cawsand Bay & Lulworth Cove
- Two high-volume water samples
- Integrated over full tidal cycles
- Target group: marine vertebrates

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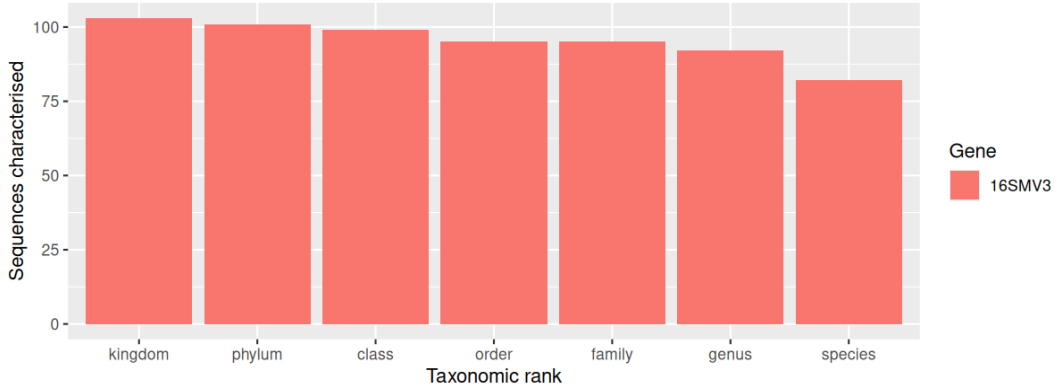
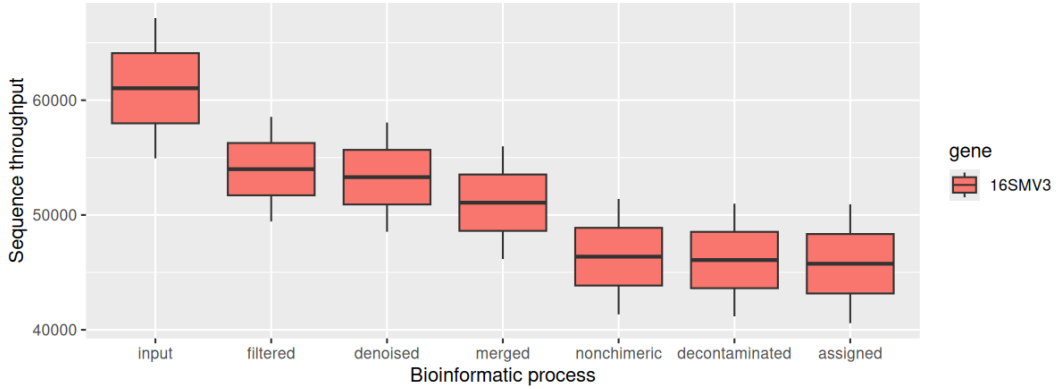
Data Outputs

From just **2 water samples**, this project produced:

- Hundreds of thousands of DNA sequences
- Hundreds of unique DNA variants (ASVs)
- Dozens of vertebrate taxa detected
- Multiple genetic haplotypes within species
- Multiple quality-control filtering steps

Modern biodiversity monitoring is a data-science problem, not just a fieldwork problem.





Key Species Detected

- European conger eel (Conger conger)
- European sardine (Sardina pilchardus)
- European hake (Merluccius merluccius)
- Sand smelt (Atherina presbyter)
- Wrasse (Labrus spp.)

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Why These Species Matter

- Important predators and food-web species
- Commercially valuable species
- Indicators of healthy marine ecosystems

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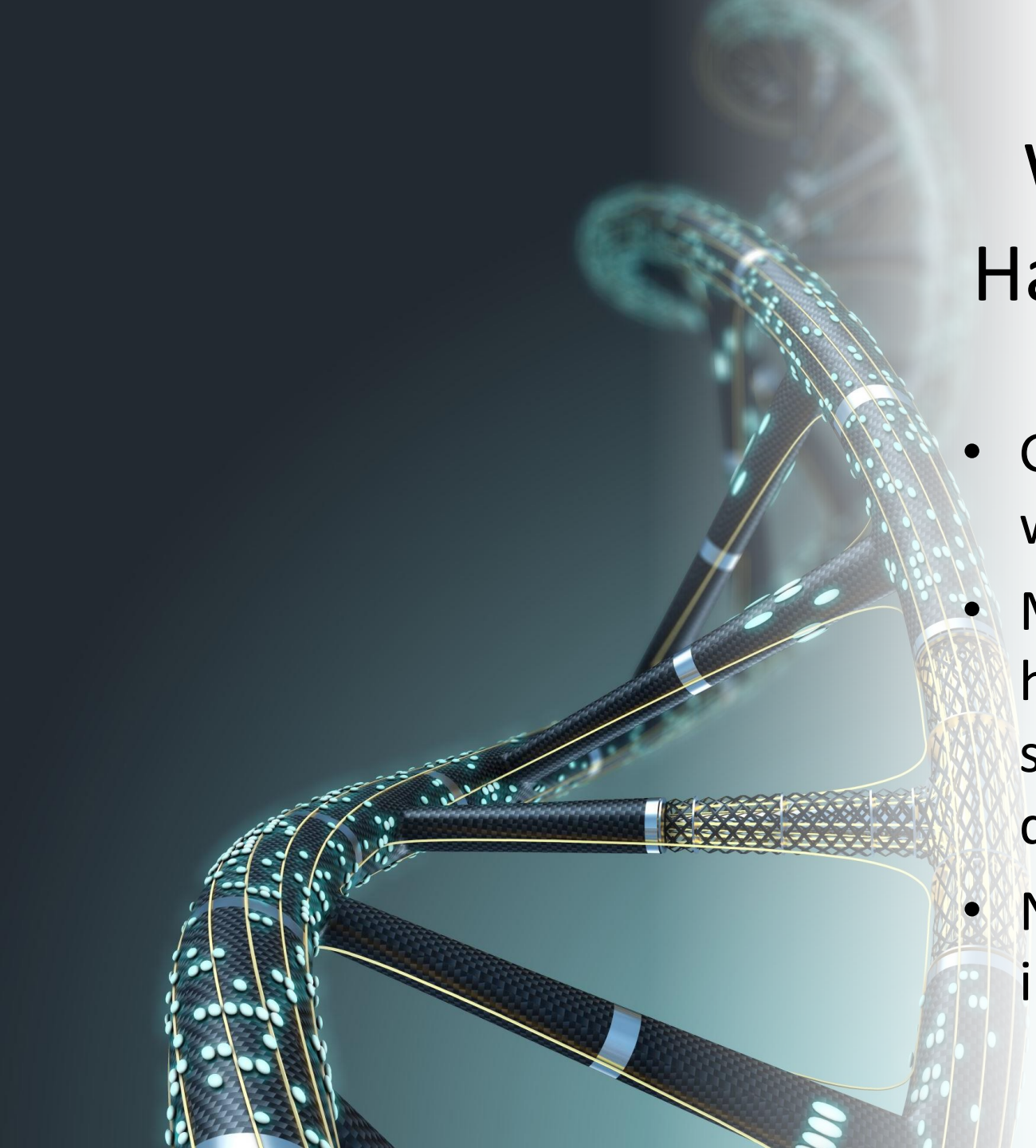

What Are Haplotypes?

- Genetic variants within a species
- Multiple haplotypes suggest genetic diversity
- Not a count of individuals

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Credibility Analysis

Why credibility matters:

- eDNA can detect rare or low-level signals
- Some detections are more certain than others

How credibility is assessed:

- Taxonomic assignment confidence
- Number of haplotypes detected
- Consistency across samples
- Prior knowledge (e.g. known regional occurrence)

Output:

- Each taxon classified as Low, Moderate, or High credibility
- Helps guide confident interpretation and decision-making

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Strengths of eDNA Monitoring

Non-invasive

Detects elusive species

Broad taxonomic coverage

Efficient and scalable

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Limitations to Understand

- Presence/absence, not abundance
- DNA can move with water
- Reference databases are incomplete

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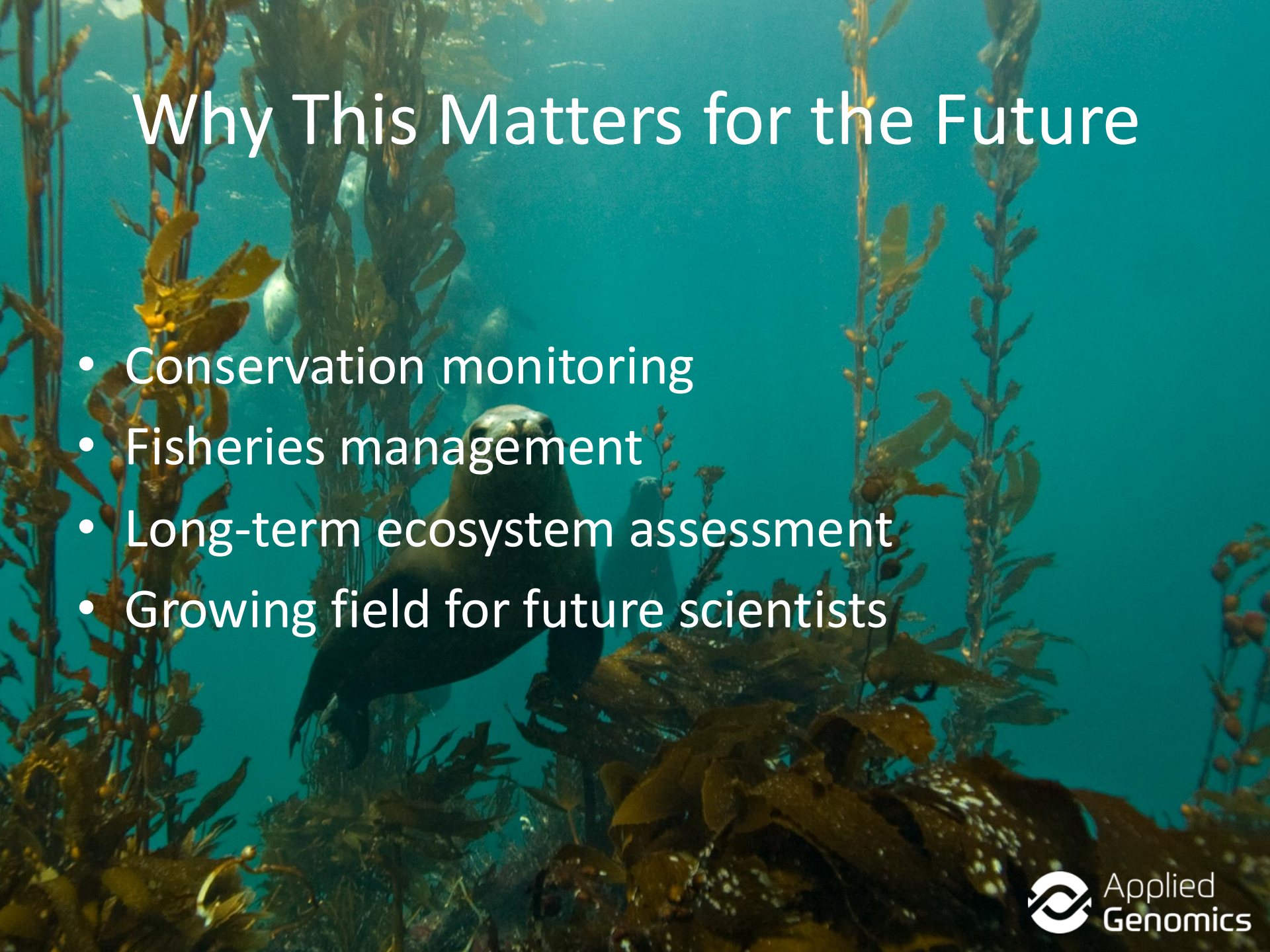

Why This Matters for the Future

- Conservation monitoring
- Fisheries management
- Long-term ecosystem assessment
- Growing field for future scientists

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