DNA-based biodiversity monitoring with NatureMetrics

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PROTEUS DATA FORUM - STATUS AND TRENDS IN DATA SOURCES AND DIGITAL TECHNOLOGIES TO SUPPORT ACTION ON NATURE AND CLIMATE

Dr Vere Ross-Gillespie:Head of Extractives & Onshore Industries


NATURE
METRICS
DNA-BASED MONITORING
CONTEXT
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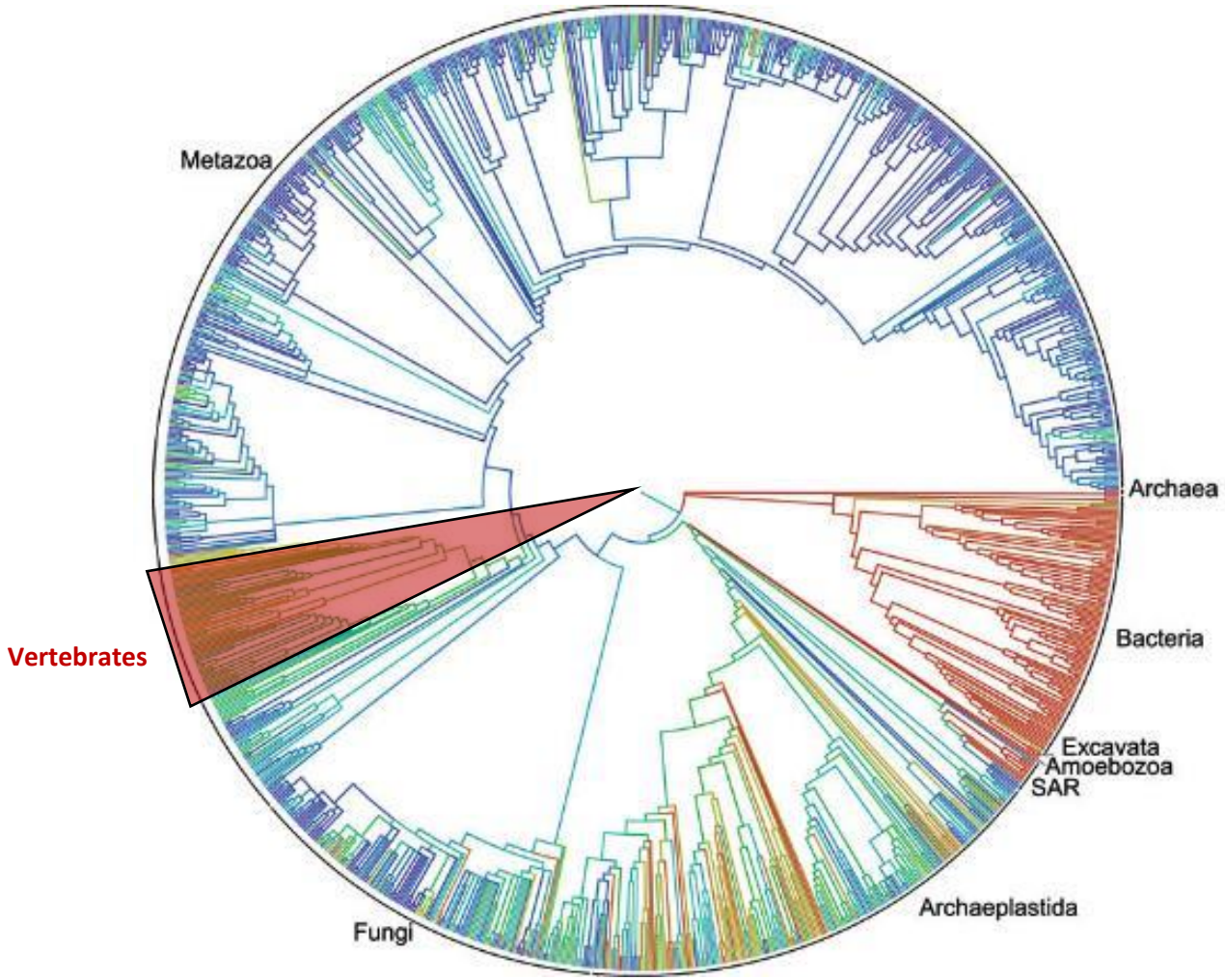
INCREASING COMMITMENT TO BIODIVERSITY

Business and finance are waking up to the need to **account for nature**

BUT BIODIVERSITY HAS A MEASUREMENT PROBLEM

Biodiversity is complex and we typically only scratch the surface with current monitoring

Meaningful metrics must simplify complexity…..not by-pass it altogether



NATURE METRICS
DNA-BASED MONITORING

BEING HELD BACK BY THE COMPLEXITIES OF NATURE

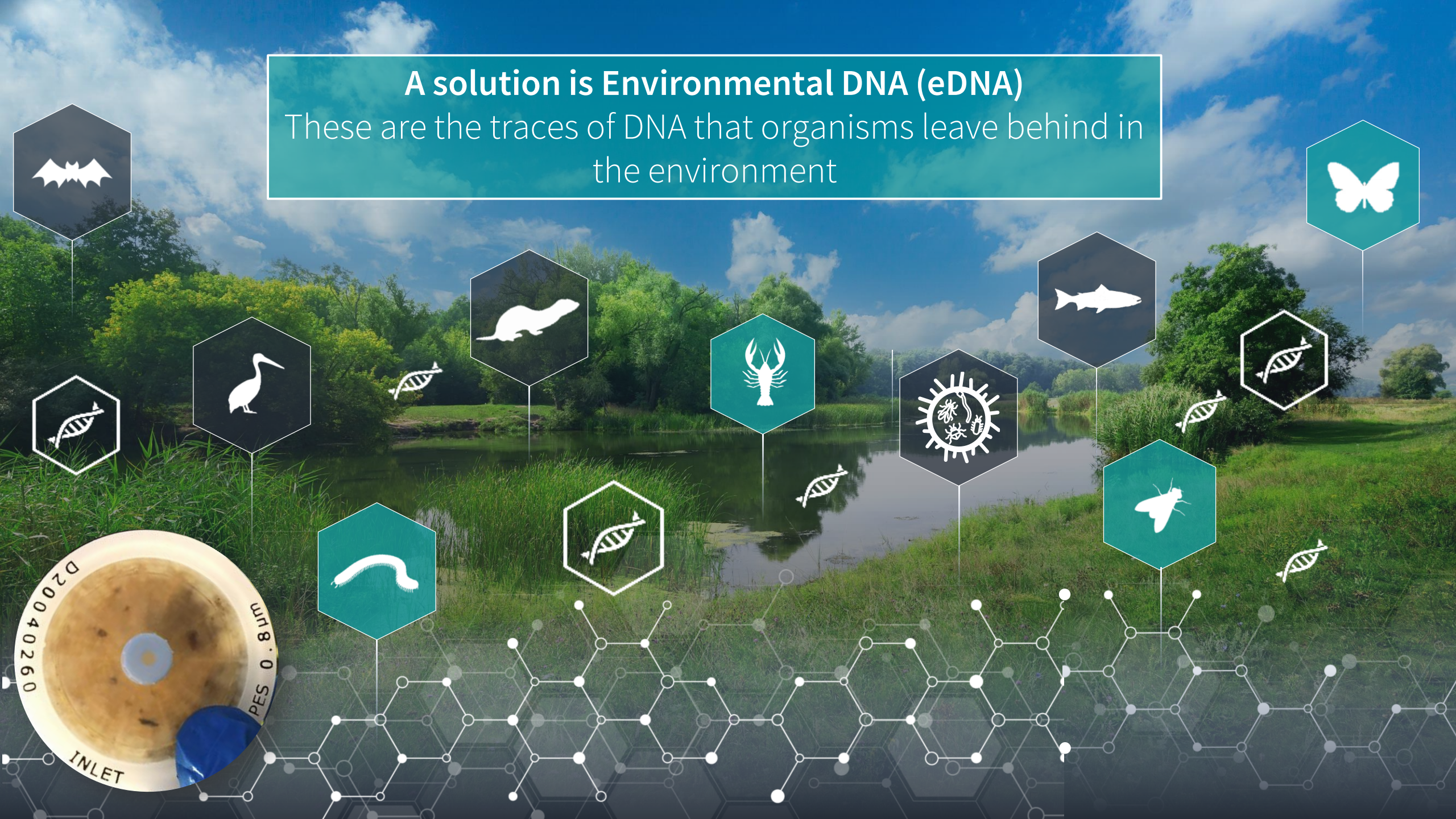
Challenges with conventional Biodiversity Monitoring

Data is expensive and time consuming to obtain. Conventional methods rely on **identification by sight** which can be time consuming and costly.

Biodiversity monitoring usually requires **large expert teams** in the field which is expensive, has **HSE concerns** and can be **weather dependent**.

Cryptic or **elusive taxa** can be hard to detect.

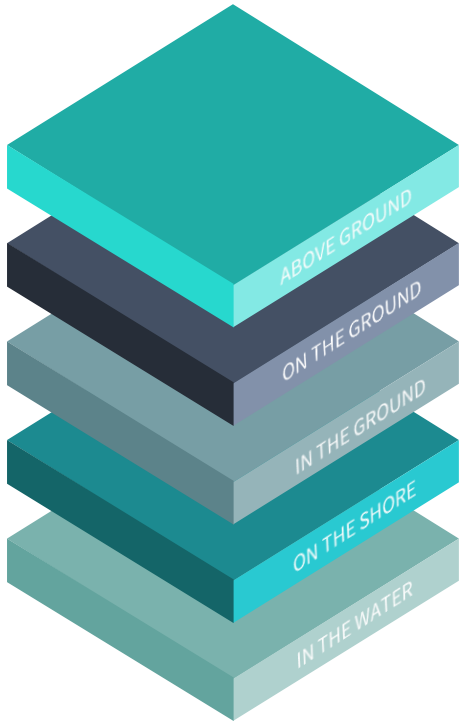
Biodiversity data and **monitoring datasets are often incomplete**


A solution is Environmental DNA (eDNA)
These are the traces of DNA that organisms leave behind in the environment
D2000402600
PES 0.8um
INLET

ENVIRONMENTAL DNA (eDNA)

- Animals shed cells containing DNA as they move (skin, mucous, faeces, urine) through environments
- Cells with DNA enters water courses
- This is environmental DNA (eDNA)
- eDNA in the water remains detectable for hours to few days
- The eDNA can be captured & used to survey species.

NATURE METRICS
DNA-BASED MONITORING



Insects
Vertebrates

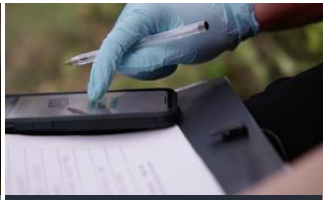
Soil fauna
Bacteria
Fungi

Vertebrates
Invertebrates
Mussels
Bacteria

COLLECT

FILTER

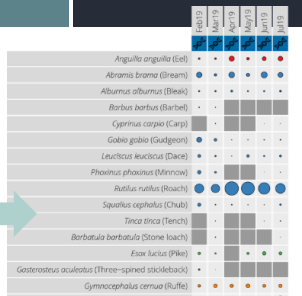
PRESERVE



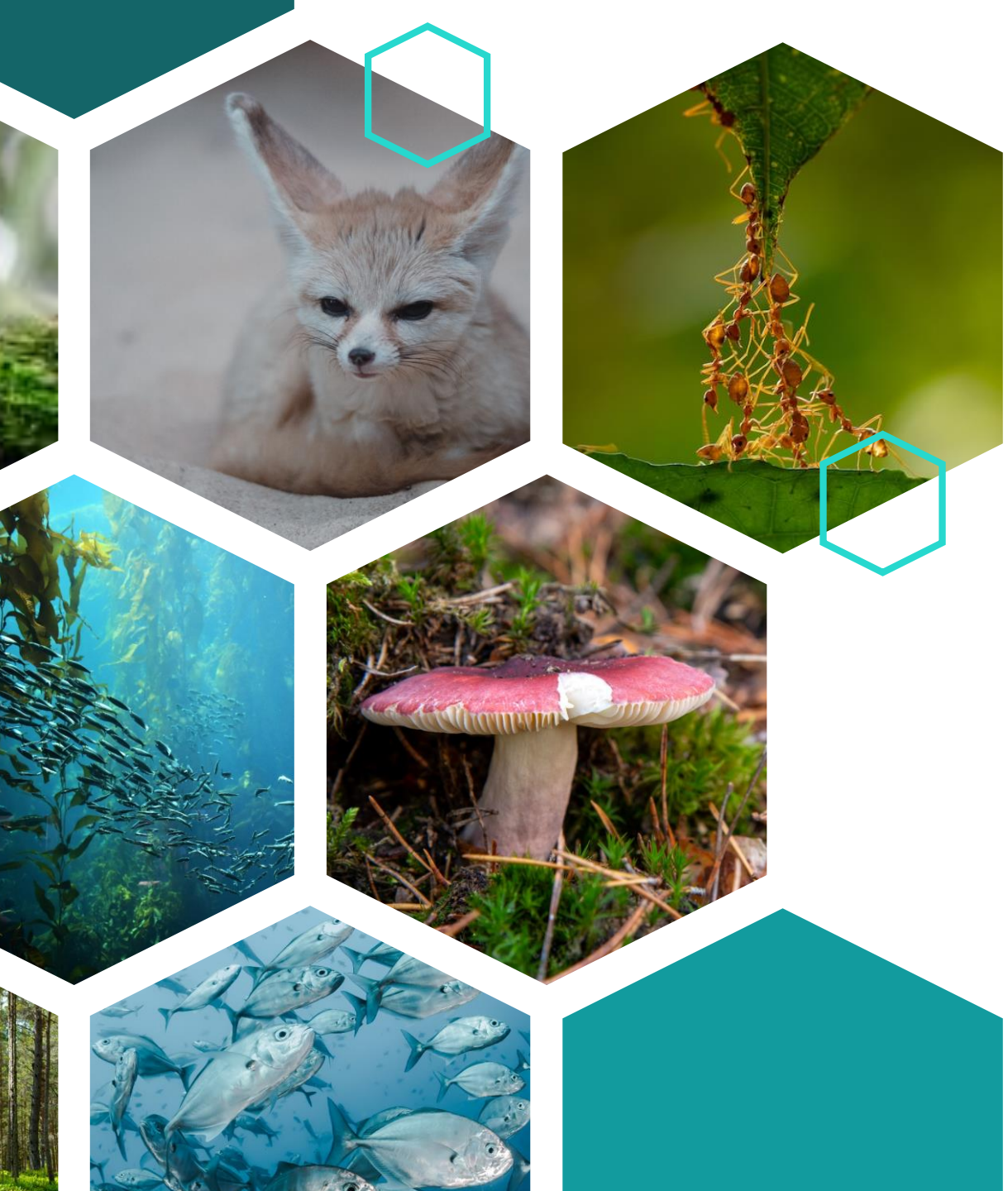
SEND

EXTRACT DNA FROM FILTER

ANALYSE



REPORT



SO WHY eDNA?

NATURE METRICS
DNA-BASED MONITORING

- Accurate, repeatable, efficient sampling
- Generate BIG data from a range of taxa
- Build baselines/reference libraries esp. in remote & inaccessible areas
- Build barcoding datasets, augment & share data across global platforms for transparency
- Reduced HSE risks and early risk identification
- Detect cryptic/elusive/species of conservation concern
- Support commitment to NPI & delivering positive biodiversity outcomes
- Assess management interventions (e.g. habitat restoration), through the mitigation hierarchy

WHO WE ARE & WHERE WE OPERATE

NATURE METRICS
DNA-BASED MONITORING

AquaBiota WATER RESEARCH

BARRICK

ERM

AECOM

IGP

Jacobs

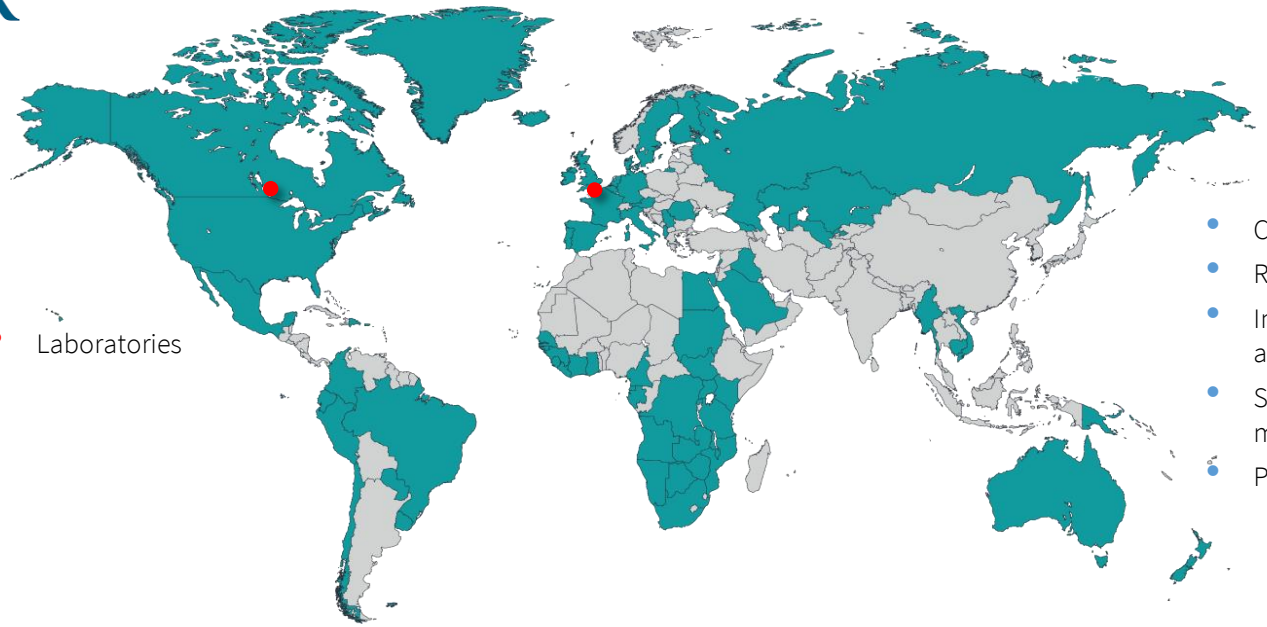
National Trust

Gardline

IUCN

THE BIODIVERSITY CONSULTANCY

FAUNA & FLORA INTERNATIONAL



- Laboratories

- Conservation
- Research
- Impact assessment
- Statutory monitoring
- Planning

AngloAmerican

Freshwater Habitats Trust

bp

WCS

defra
Department for Environment Food and Rural Affairs

NATURAL ENGLAND

REPSOL

WWF

FUGRO

Marine | Infrastructure | Extractives | Conservation | Water / Utilities | Research | Agriculture | Renewable Energy

~130 employees | 1000+ client/projects | 100+ countries

WHY IS eDNA TRANSFORMATIONAL?

NATURE METRICS
DNA-BASED MONITORING

Sensitivity

Scalability

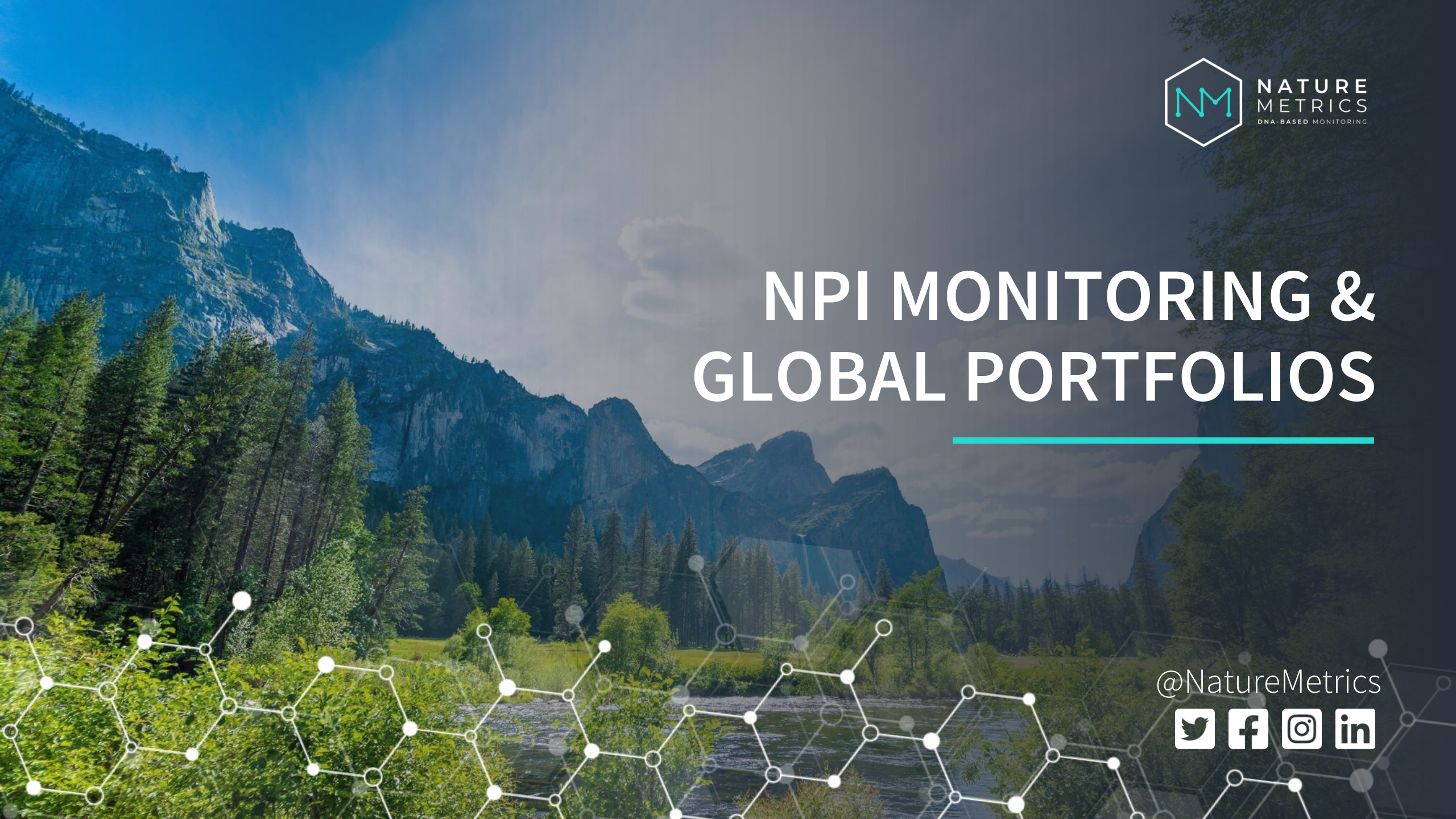
Unique Habitats

R&D

Contribute to Outreach

Mitigate Risk

Efficiency


NATURE
METRICS
DNA-BASED MONITORING
NPI MONITORING &
GLOBAL PORTFOLIOS
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eDNA INFORMS THE MITIGATION HIERARCHY

AngloAmerican | NATURE METRICS DNA-BASED MONITORING

COMPLETED

ORDER OF DECREASING PREFERENCE

OFFSET

RESTORE

MINIMISE

AVOID

ISIBONELO:
Off-set/Restoration

QUELLAVECO:
Early development

WOODSMITH:
EIA/Compliance

SAKATTI:
EIA/Planning

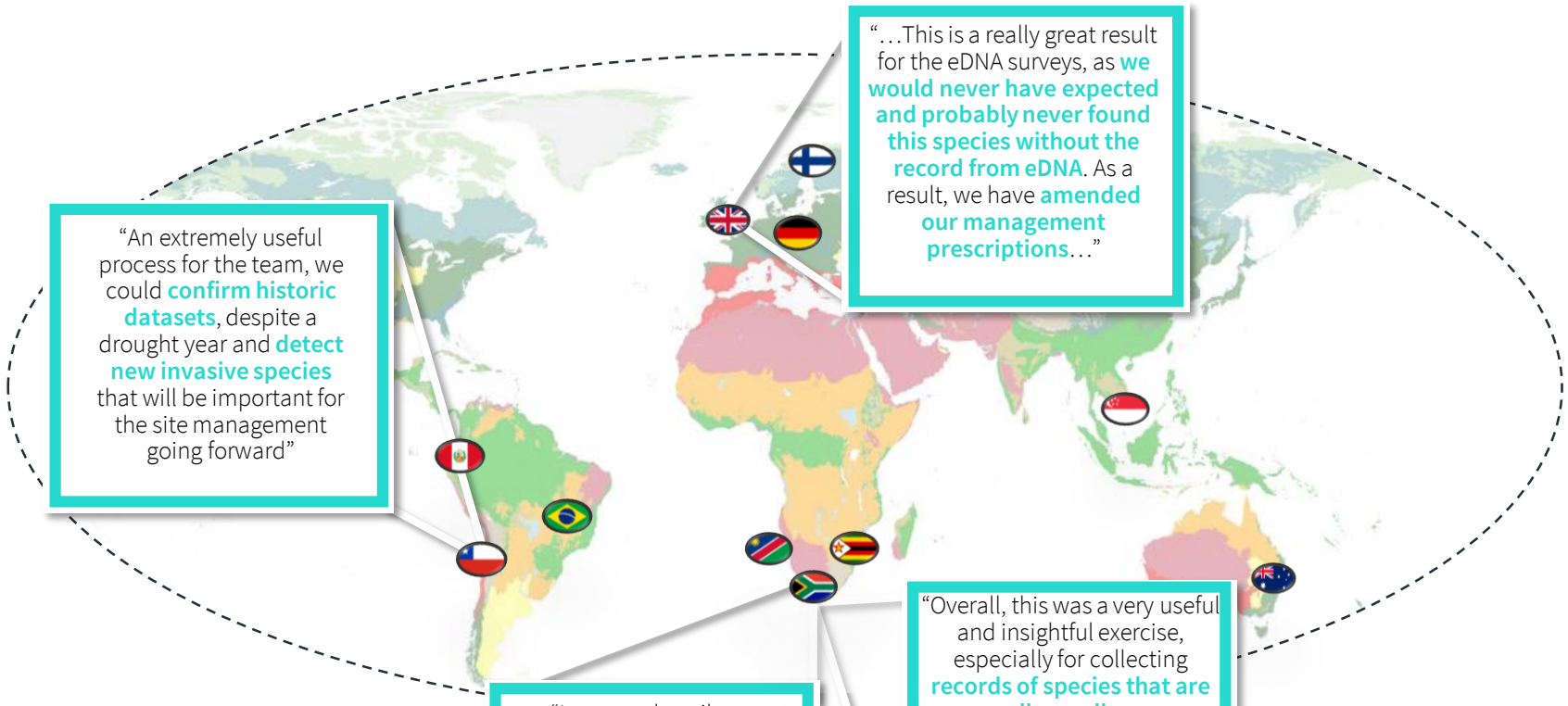
GDG:
Exploration

- Early surveying to **develop baseline** for the project
- **Monitoring to track changes** in the nature and the extent of the impacts on biodiversity
- Prior to intervention **planning for restoration and offset**, measure biodiversity and then track changes to monitor progress in species and habitat recovery.

eDNA MONITORING ACROSS A PORTFOLIO

Over 1600 samples collected in 1st season sampling – Global BU's Anglo American

15 sites globally, terrestrial & marine including site-based training & citizen science



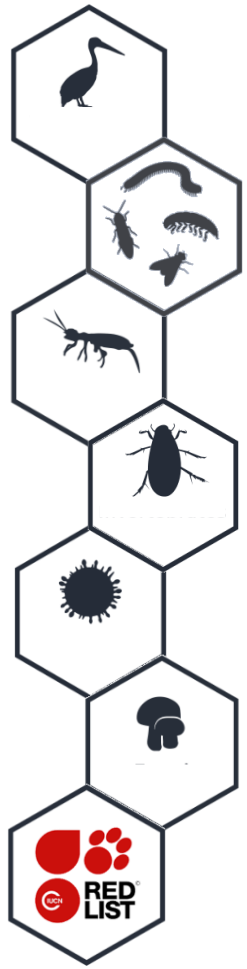
"An extremely useful process for the team, we could **confirm historic datasets**, despite a drought year and **detect new invasive species** that will be important for the site management going forward"

"…This is a really great result for the eDNA surveys, as **we would never have expected and probably never found this species without the record from eDNA**. As a result, we have **amended our management prescriptions**…"

"I cannot describe to you or put in words the **value of this data** in a monetary sense.....[it] has **confirmed so much of what we thought to be happening** on site but couldn't prove until now"

"Overall, this was a very useful and insightful exercise, especially for collecting **records of species that are generally smaller, more recluse and hard to detect**… The results further **add to our actual species** observed lists whilst **providing confirmation of expected species**…"

Species Detected



749 Vertebrates,

793 Eukaryotes

559 Sediment In-fauna

2225 Invertebrates including barcoding

4532 bacteria,

1787 fungi

26 species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DNA-BASED MONITORING
SAMPLING
EFFICIENCY
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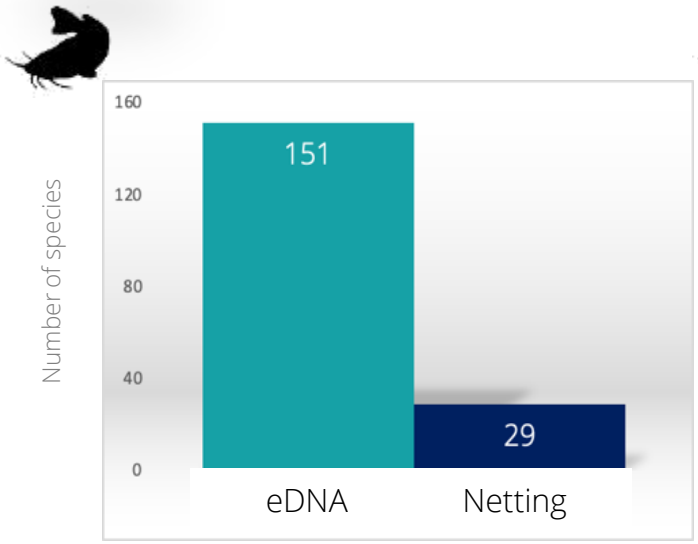
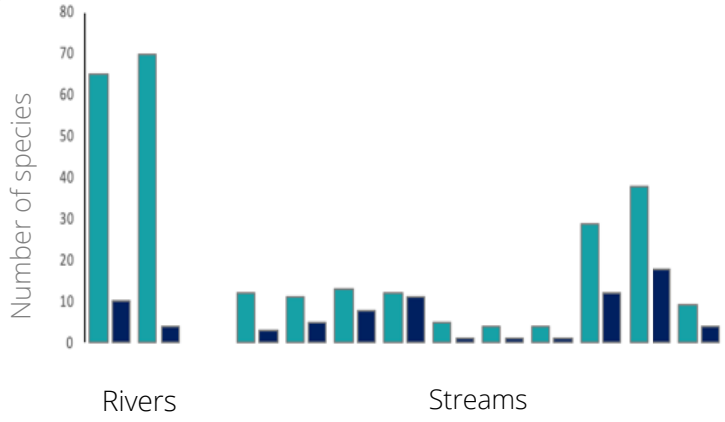
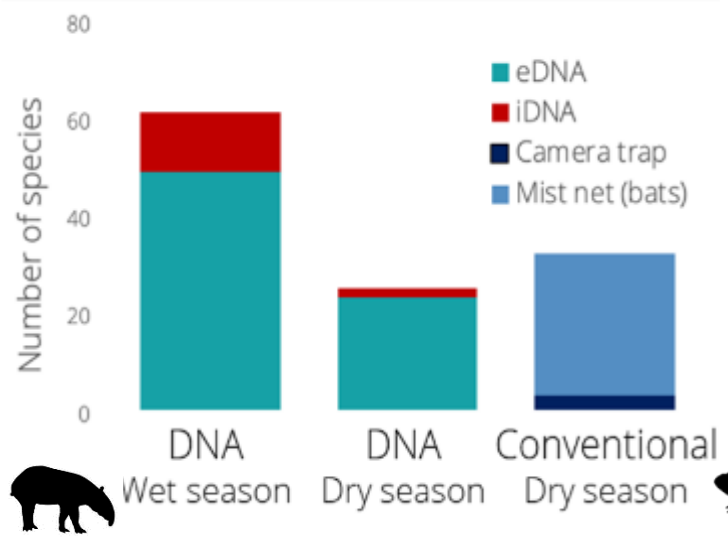
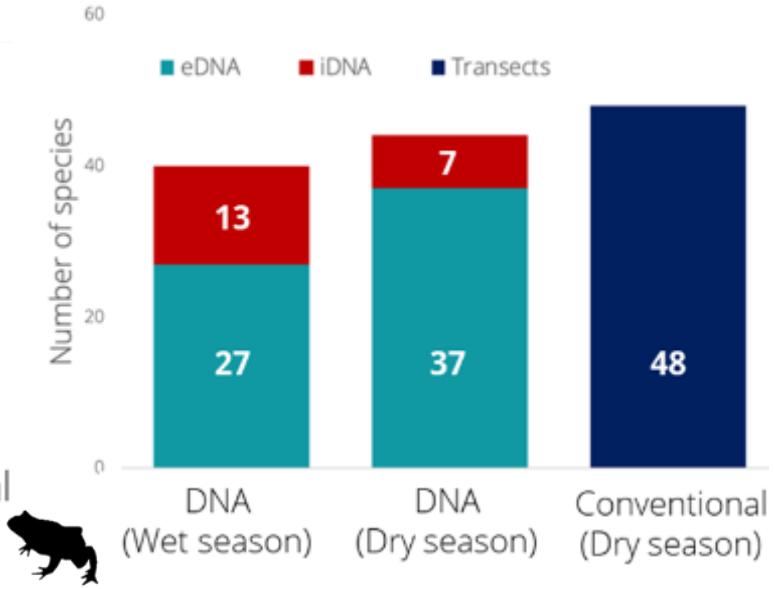
COMPARISON OF METHODS









NATURE METRICS
DNA-BASED MONITORING

REPSOL

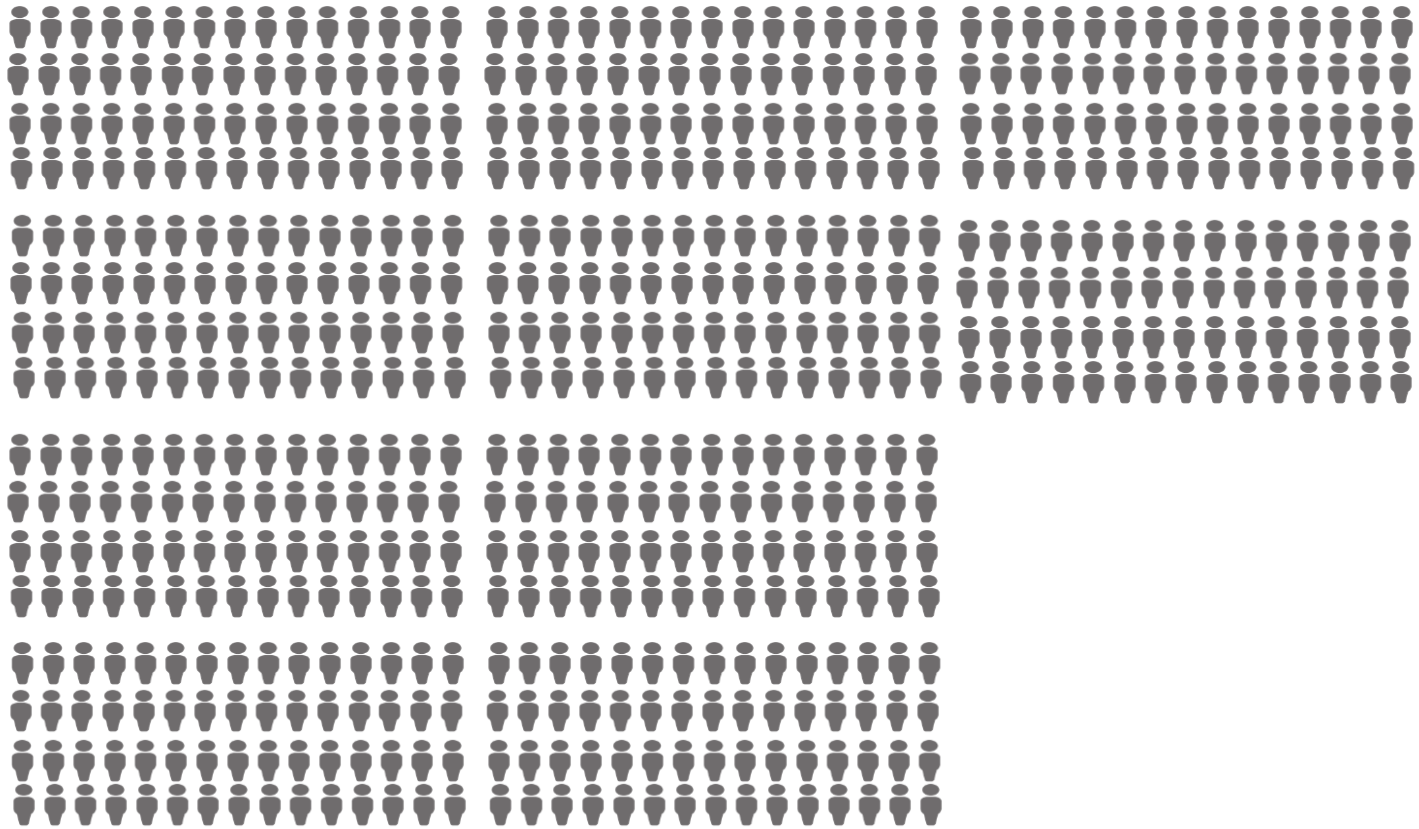
COMPLETED

METHOD COMPARISON DURING EIA - PERU

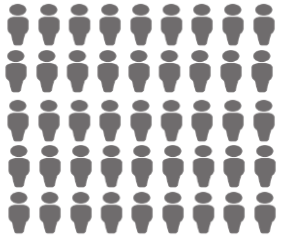
At 2 river sites and 10 stream sites, the client compared aquatic eDNA with the netting process

EXAMPLE COSTS – PERSON DAYS

Conventional Methods 600 person days

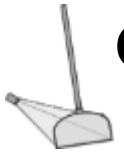


eDNA 50 person days



TAXANOMIC YIELD PER UNIT SAMPLING EFFORT

Data from a completed project revealed a DNA based survey yielded almost a factor of 27x more species than conventional surveys per unit sampling effort



Conventional methods

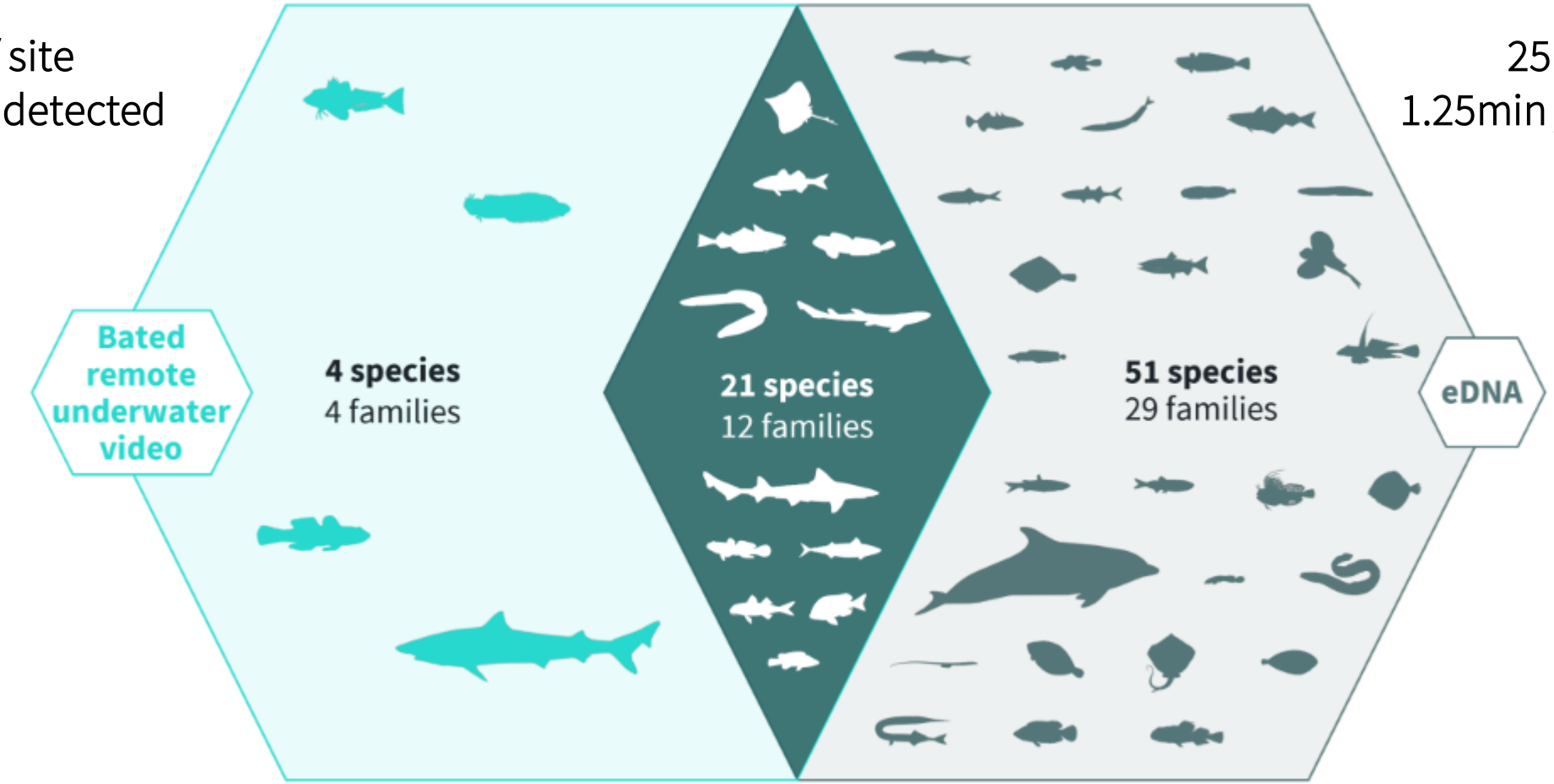
eDNA

Taxonomic Group	Total number of taxa detected using conventional survey methods	Total number of taxa detected using DNA based survey methods
Fish	34	106
Major mammals	4	19
Minor mammals	29	7
Reptiles	26	2
Amphibians	48	44
Birds	169	25
Insects	118	753
Total taxa	**428**	**956**
Total sampling effort (person days)	600	50
Taxa per unit sampling effort (person days)	**0.71**	**19.12**

TAXANOMIC YIELD PER UNIT SAMPLING EFFORT

eDNA outperforms traditional visual surveys in underwater marine forests – Sussex

7hrs/ site
8hrs / spp detected



25min/ site
1.25min / spp detected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DNA-BASED MONITORING
INTEGRATION WITH
REMOTE SENSING
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NET POSITIVE IMPACT OVER LARGE AREAS

FAUNA & FLORA INTERNATIONAL

NATURE METRICS
DNA-BASED MONITORING

UNDERWAY

SAMPLING
Survey design and eDNA sampling

MAPPING
Biodiversity landscape mapping

RANKING
Identification of biodiversity values across the landscapes

RESTORING
Site restoration and offset planning

MONITORING
Measurement of NPI success

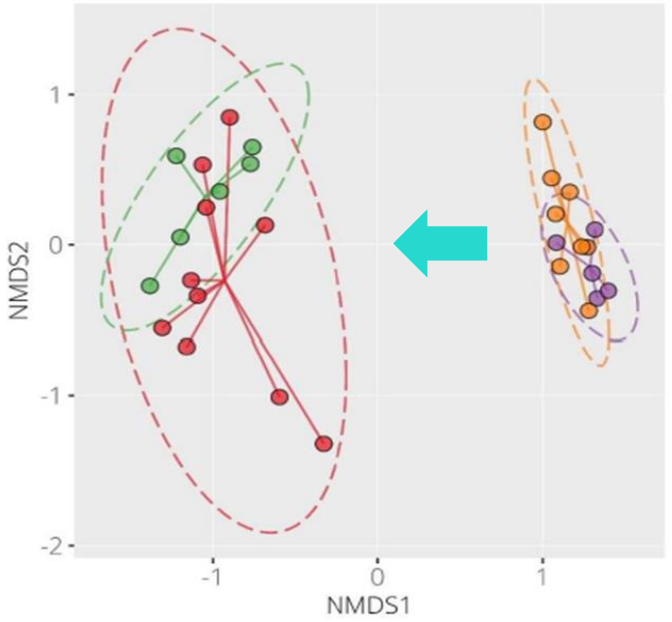
- Insects as a proxy
- Ground-truthed data
- Used to create a layer for planning
- Calibrated to remote sensed data
- Sea-scape iNPI?

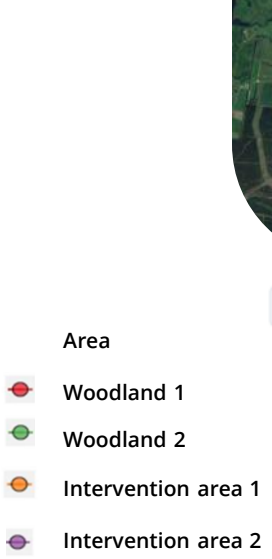
WE CAN QUANTIFIABLY TRACK RESTORATION PROGRESS

NATURE METRICS
DNA-BASED MONITORING

UNDERWAY

- Tracking community composition shifts until relatively similar
- Target vs. counter target
- Qualitative with NMDS plots





- Quantitative Machine learning model - Trained on target communities
- Samples fed in each year from different areas – model indicates closeness to community target score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DNA-BASED MONITORING
ALIGNMENT WITH TNFD
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TNFD & LEAP

To implement the LEAP approach in practice, organisations need access to **high-quality, trusted, decision-useful data** on **nature-related risks and opportunities**.

Companies first need to **Locate** sites that have a high risk to business activities and then **Evaluate** and **Assess** impacts on biodiversity linked to those risks. High risk sites then require on-the-ground-data to **Prepare** to respond, as well as to track and disclose biodiversity impacts.

1. Locate interface with nature	**2. Evaluate** Dependencies & impacts	**3. Assess** Risks & opportunities	**4. Prepare** To respond and report
• Global screening tools identify sites with high risk to business and / or nature • **Local calibration using site-based tools such as eDNA**	• Understand business dependencies on nature (ecosystem services) • Identify **how** business processes are **driving nature impacts**	• What are the **risks** and opportunities **to the business** • What are we already doing / **should be doing**	• Strategy and resource allocation • **Setting targets to define and measure progress** • Reporting

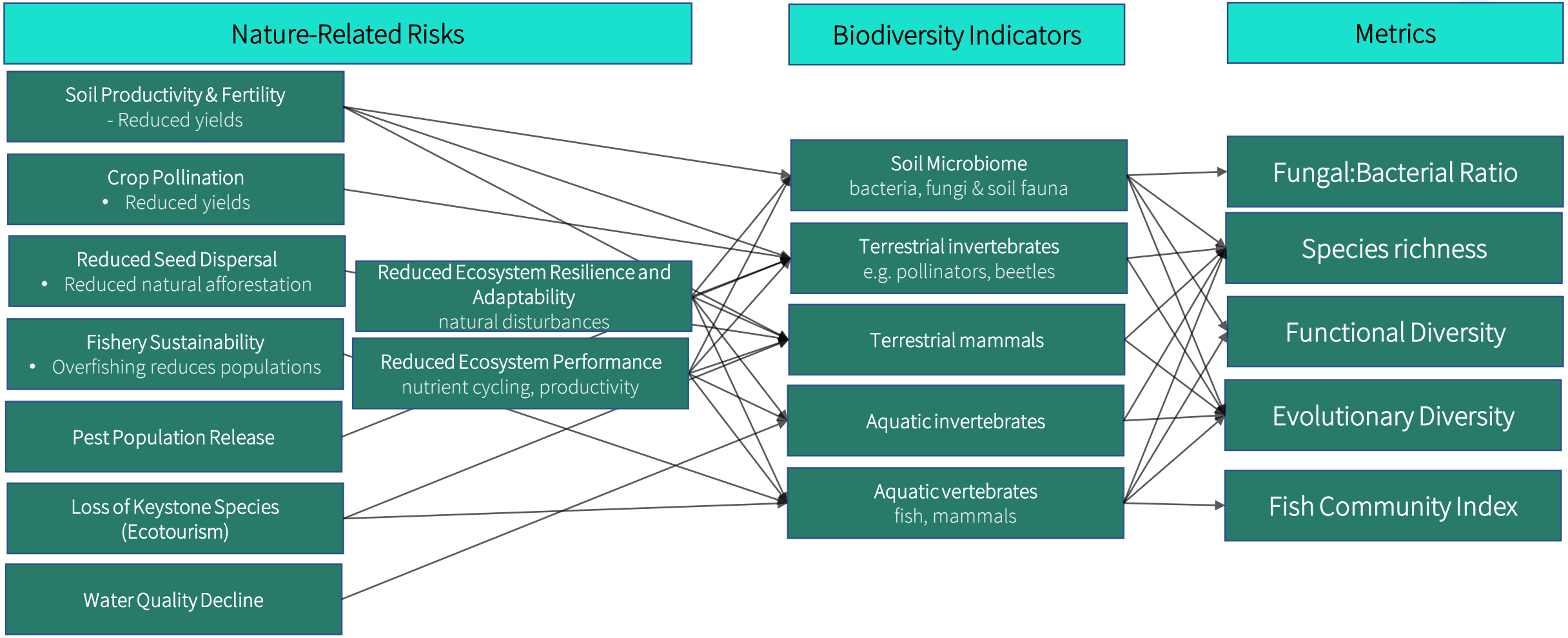
TNFD

Evaluate
Dependencies & Impact

Assess
Risks & Opportunities

Monitor Impacts on Nature, which Informs Risk

Declines in the State of Nature (Metrics) leads to increased risks for businesses, and we can help companies track their impacts on biodiversity that directly influence those risks

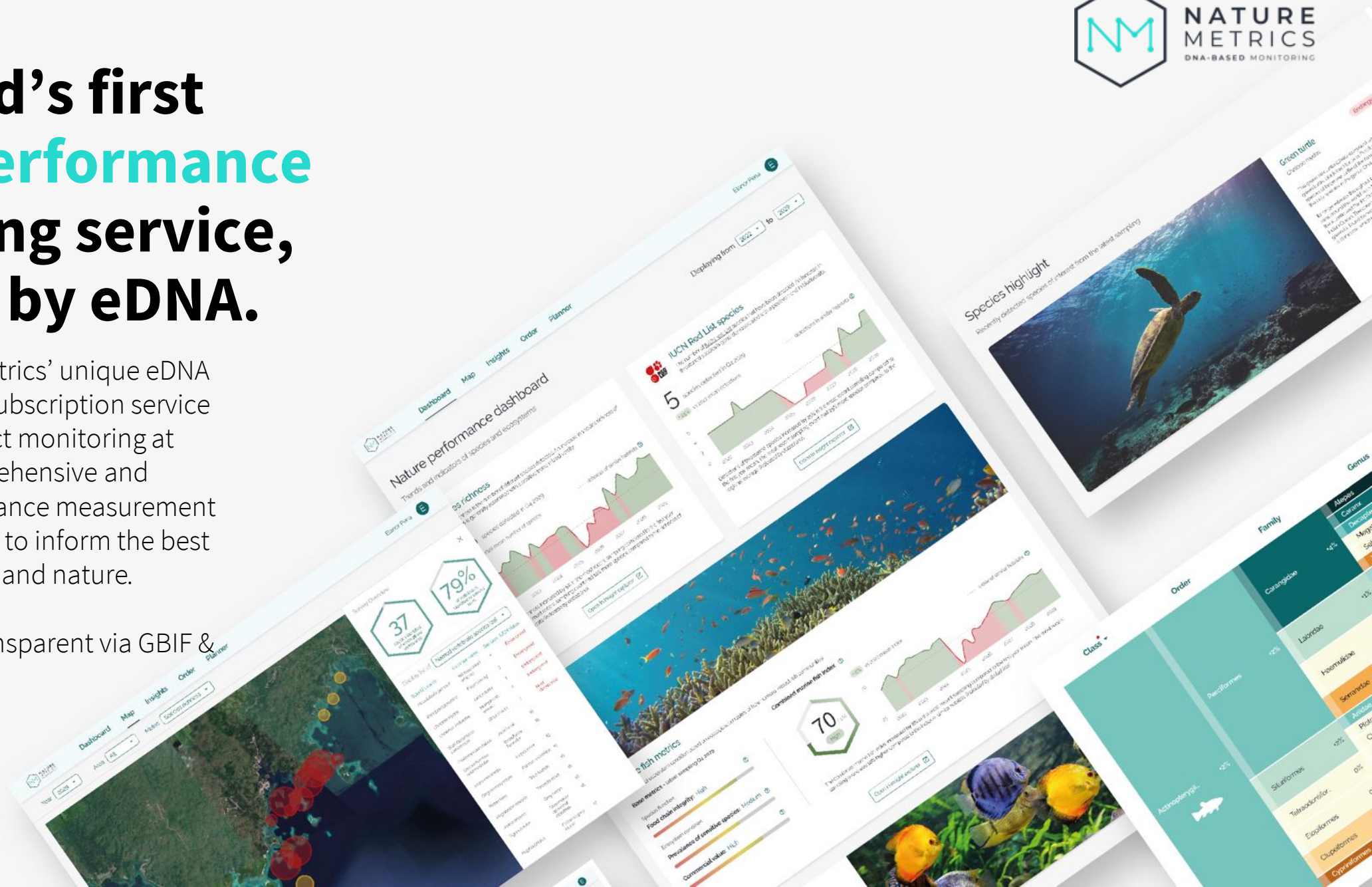


NATURE METRICS
DNA-BASED MONITORING

The world's first nature performance monitoring service, powered by eDNA.

Powered by NatureMetrics' unique eDNA technology, the new subscription service provides nature impact monitoring at scale, enabling comprehensive and standardised performance measurement on biodiversity health, to inform the best decisions for business and nature.

Data can be made transparent via GBIF & eBioAtlas



IUCN

NATURE METRICS
DNA-BASED MONITORING

eBioAtlas

A new global biodiversity data layer

A transparent service for reporting and disclosure


NATURE
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DNA-BASED MONITORING
INNOVATION &
DEVELOPMENT
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DRONES & R&D

Safe monitoring from inaccessible locations

Overview & Objective

- eDNA & Water Chemistry
- Rapid, safe, automated deployment
- Imagery & Lidar

DNA Based methods

- Different depths
- Samples analysed for several taxonomic groups
- Remaining DNA stored for future assessments

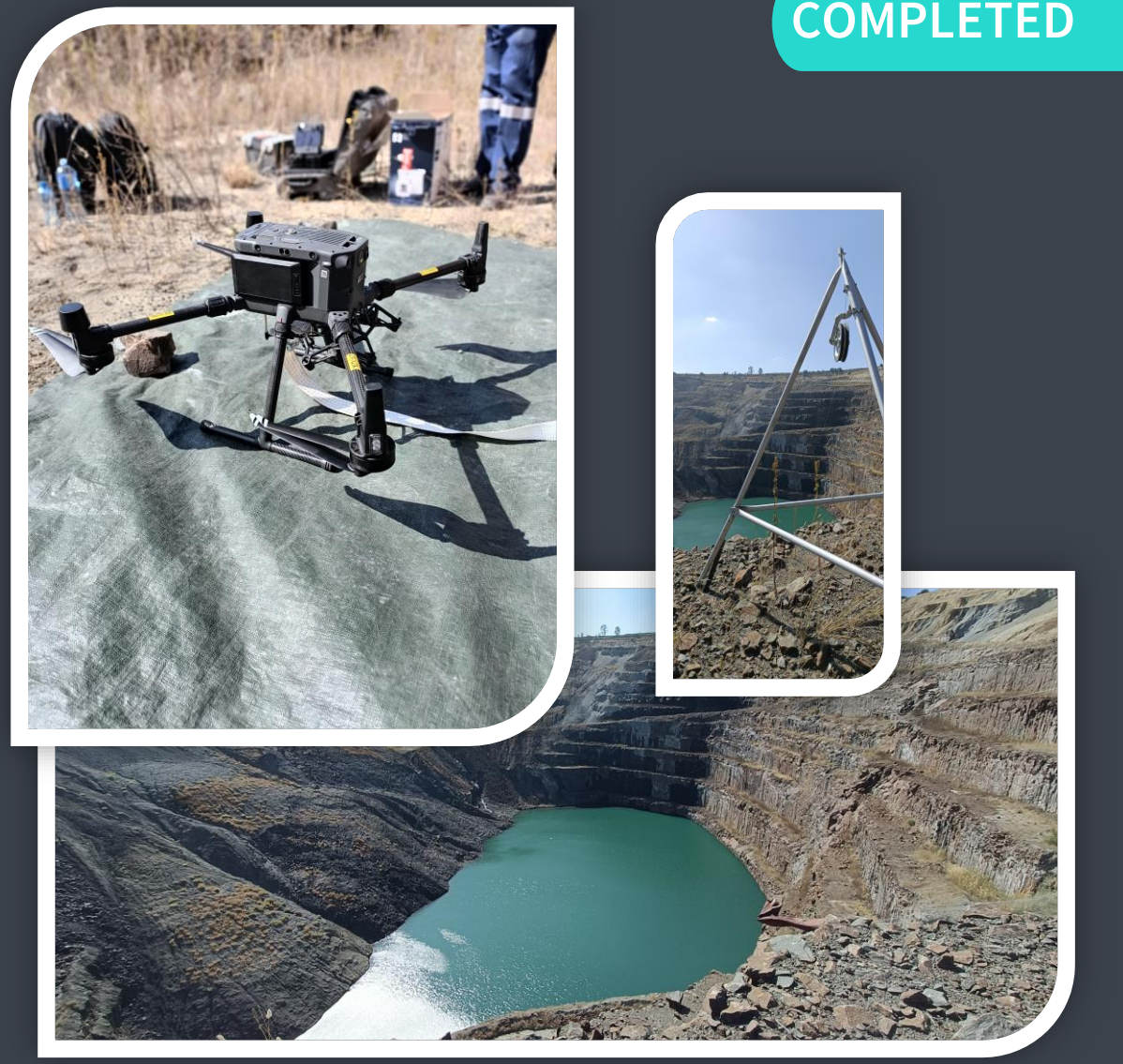
R&D for Key Taxonomic Groups

- Sharks & Elasmobranchs – Many critically endangered
- Great Apes and Chimpanzees – Critical habitat triggers
- Diatoms – measure of integrated water quality

DE BEERS GROUP

NATURE METRICS
DNA-BASED MONITORING

COMPLETED



AUTONOMOUS SAMPLING R&D

Air DNA Sampling

Overview & Objective

- eDNA & Air Chemistry
- Passive & Automated deployment

DNA Based methods

- Static stations
- Samples analysed for several taxonomic groups

Passive Aquatic eDNA Sampling

DARTMOUTH OCEAN TECHNOLOGIES (DOT) SAMPLER

NM New Partnership with DOT

https://dartmouthocean.com/nature metrics-and-dartmouth-ocean-technologies-partner-provide-autonomous-marine-edna-sampling

RAINFOREST X PRIZE - SEMIFINALS

SPACE4GOOD

NATURE METRICS DNA-BASED MONITORING

COMPLETED

TEAM Re-Forest-ER

INDUSTRY GUIDANCE

NATURE METRICS
DNA-BASED MONITORING

COMPLETE

THE BIODIVERSITY CONSULTANCY

Stantec

bp

International Association of Oil & Gas Producers

Contribution to

Applicable to onshore & offshore environments, all phases of a project lifecycle and stages of the mitigation hierarchy

Early-stage exploration & baselining insights - Pilot site

A once-off snapshot of a site's biodiversity for screening – mainly aquatic

Early-stage risk mitigation, to inform planning & future monitoring

Can be conducted by exploration teams

Up to 200ha*

~£15,000 – 30,000

Seasonal monitoring for comprehensive baseline & trend monitoring

A robust baseline for a site over a year, multiple seasons and different habitats & locations

Integration of data with biomonitoring & water quality info for trend monitoring

Site inventories & contribution to local / regional knowledge

Up to 1000ha*.

~£30,000 - 50,000

Comprehensive multi-year monitoring & management across logistics chain

Advanced insight evidencing over time and project phases & inform management actions

Ecosystem level targeting, including soil & water biodiversity & pit-port

Make data-driven decisions using dashboard

Up to 5,000ha*

~£50,000 - 150,000

Nature intelligence & disclosure over land/sea-scape towards Net Positive Impact

Landscape level multi-year monitoring for improved planning

Ecosystem level targeting, including soil & water biodiversity to evidence NPI

Dashboard & modelling outputs with remote sensing

Up to 25,000ha*

~£150,000 – 200,000

*Hectares may vary depending on site context & sampling is easily scalable

THANK YOU

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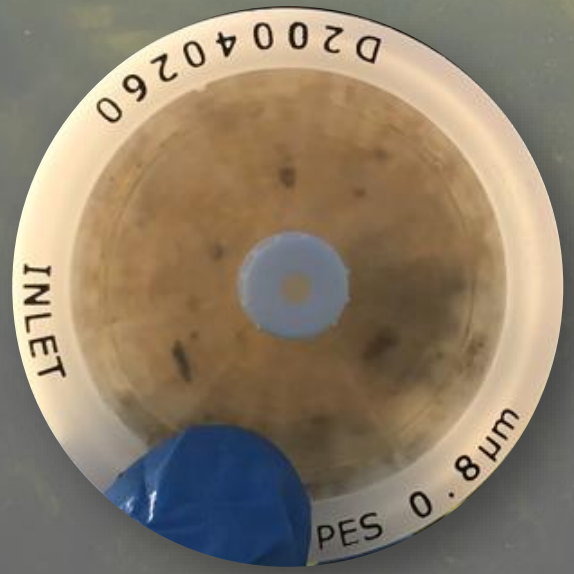
NATURE METRICS
DNA-BASED MONITORING

Extra slides if needed

ALL species contain DNA and leave traces of their genetic code in the environment (eDNA)

eDNA can be captured by filtering water from rivers, lakes & oceans. It is then analysed in a laboratory to identify the species present in the area.

We can also extract DNA from soils, sediments, and even in the future we will pull it directly from air



WE ARE ENTERING A NEW ERA

NATURE METRICS
DNA-BASED MONITORING

Nature was a curiosity

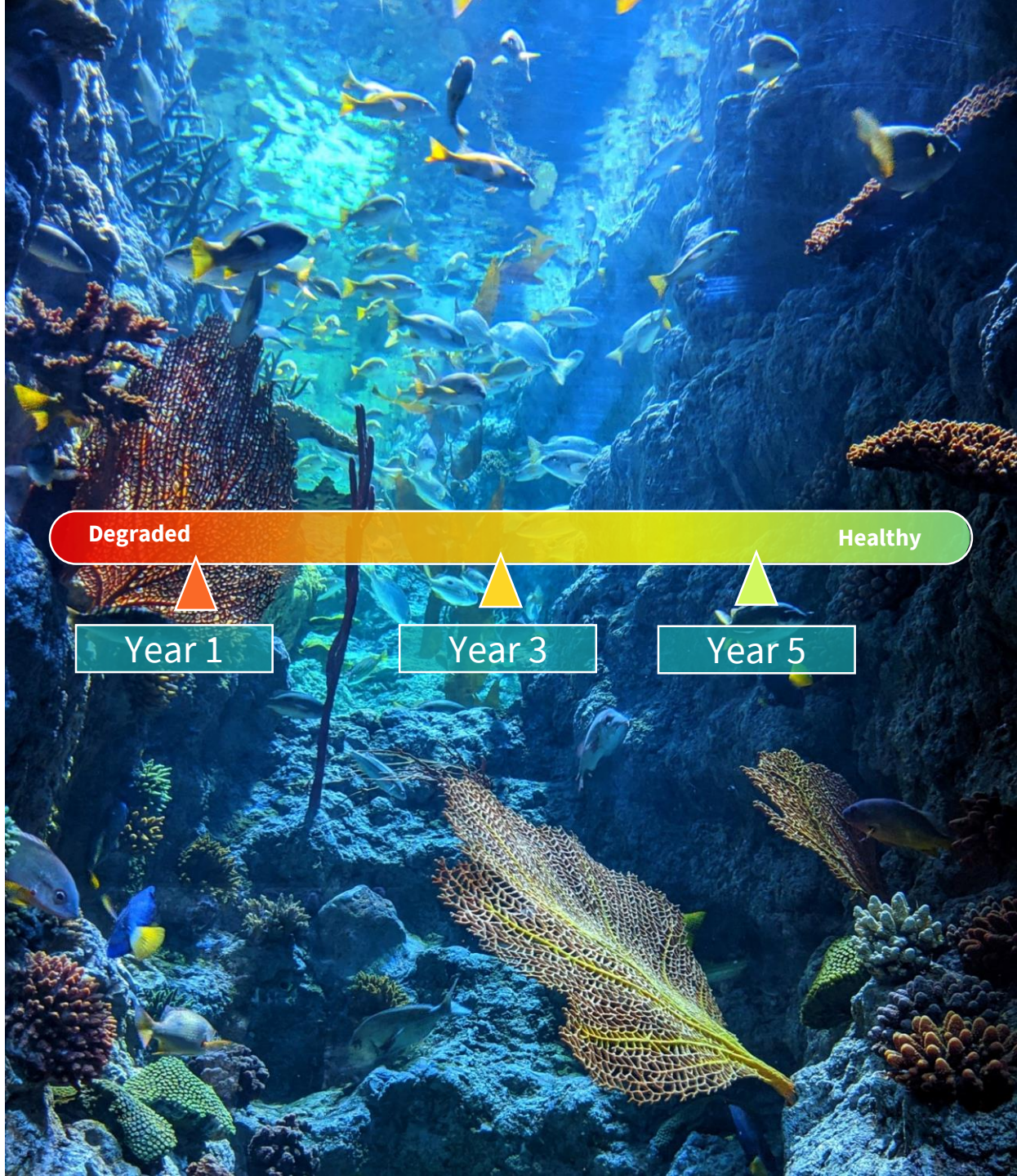
Nature was a resource

Nature is at risk

Nature must recover

INDUSTRY NEEDS TRANSPARENCY

- For the private sector to **value** and invest in something, they need an **objective, verifiable measure** of its **quality**
- **Incentives are NB** (First Mover/Credits)
- Conservation and restoration require *outcome* metrics
- Biodiversity is a **big data** problem
- How to convert **complexity** into something **simple, universal** and **meaningful**?



WHAT IS NEEDED?

Industry perspective

- Trustworthy digital data
- Efficicency at scale
- Cost savings
- Risk mitigation & Safety
- Data for compliance & transparency
- Data for management decisions

Global perspective

- Collaboration
- Urgent Action
- Stewardship

Academic perspective

- More monitoring & more data
- Accuracy
- New tools & innovation
- Funding
- No Greenwashing

NATURE METRICS
DNA-BASED MONITORING

GROUP DISCOVERY & GEOSCIENCE

Australia & Germany

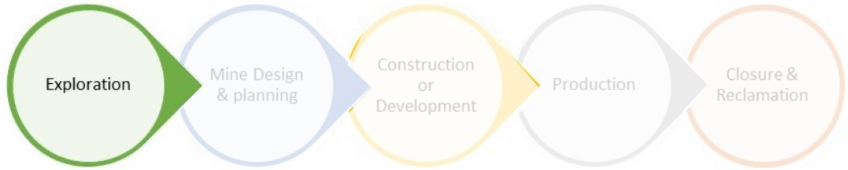
Anglo American

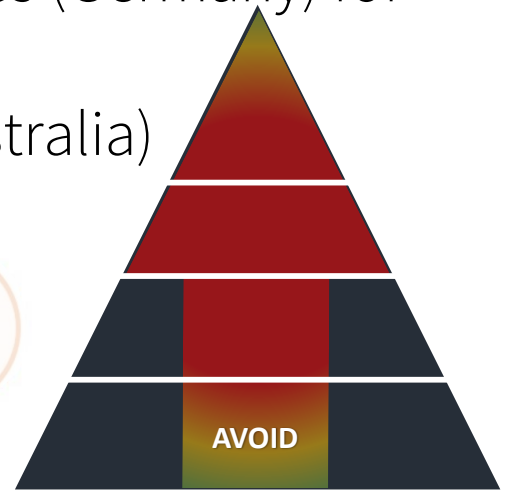
AngloAmerican

UNDERWAY

Outcomes

- Exploration geologists trained in eDNA collection
- Valuable Baseline data collected in earliest project stage for long term monitoring
- Risk mitigation – key species detected
- Capacity building
- Large datasets for invertebrates (Germany) for water quality monitoring & vertebrates/invertebrates (Australia)

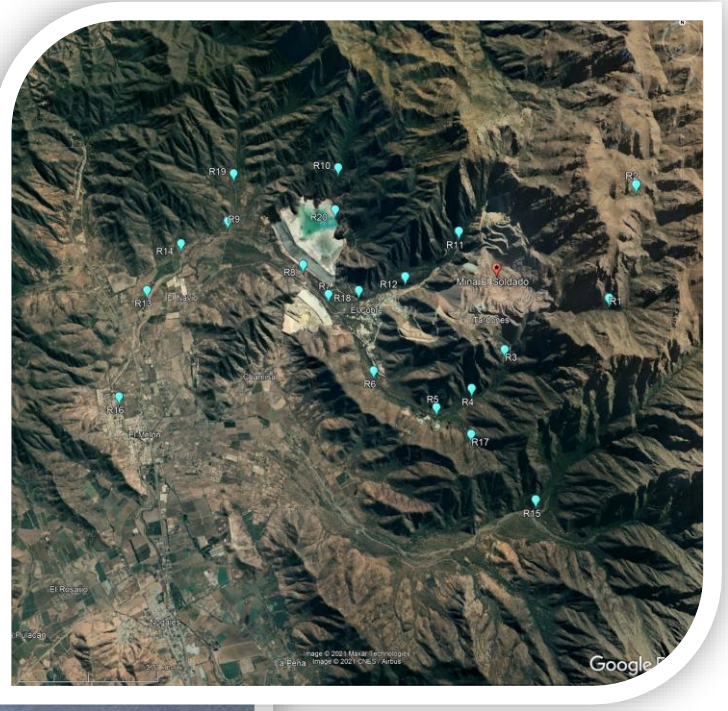




EL SOLDADO COPPER MINE

Nogales, Chile

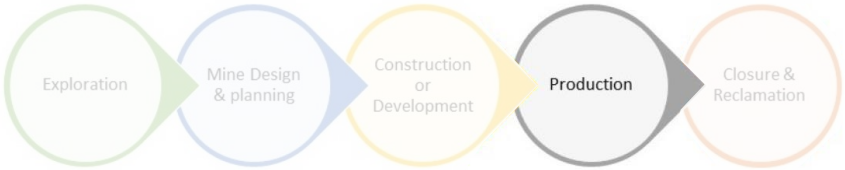
Anglo American

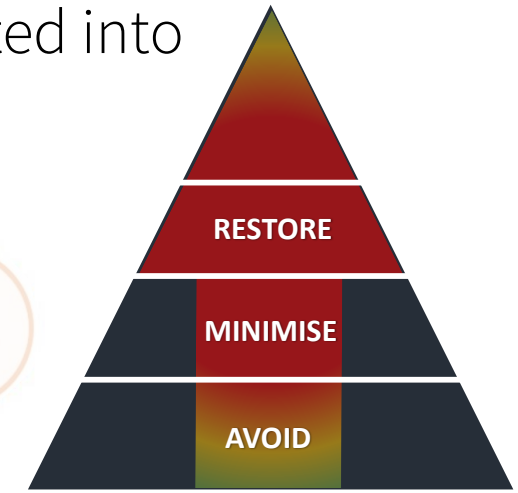


Key Outcomes

COMPLETED

- Strong agreement between historical data & eDNA
- New invasive species records
- Species presence confirmed at new sites
- New species records & R&D
- Barcoding confirmed species
- eDNA integrated into monitoring





This is a **transformation** in scale

No other method can deliver data across the tree of life from a simple, low-cost, participatory field effort

Accessibility

Anyone in the world can collect a sample

+

Comprehensiveness

Everything in one sample - from microbes to megafauna