



WE ARE **NATUREMETRICS**, DELIVERING
**eDNA-based Biodiversity
Monitoring**

DR KAT BRUCE, FOUNDER



INTRODUCING ENVIRONMENTAL DNA

INTRODUCE NATUREMETRICS

CASE STUDIES

DNA METABARCODING

Extract total DNA from sample



Sequence on high-throughput
sequencing platform



Match sequences against reference
libraries to assign taxonomy



**NATURE
METRICS**
DNA-BASED MONITORING



Insects

Insects
Vertebrates
Plants



Soil

Soil fauna
Bacteria
Fungi
Plants



Water

Vertebrates
Mussels
Crayfish
Bacteria

ENVIRONMENTAL DNA (eDNA)

Traces of organisms

Mostly from water



ENVIRONMENTAL DNA

- Animals shed cells that contain DNA
- The water contains genetic traces from wildlife (eDNA)
- eDNA in the water remains detectable for a few days
- We can capture the eDNA by filtering the water



IN THE LAB



1. EXTRACT DNA



2. AMPLIFY DNA



3. SEQUENCE DNA

Usually some
DNA left over

Choose a
taxonomic group

300,000 sequences
per sample

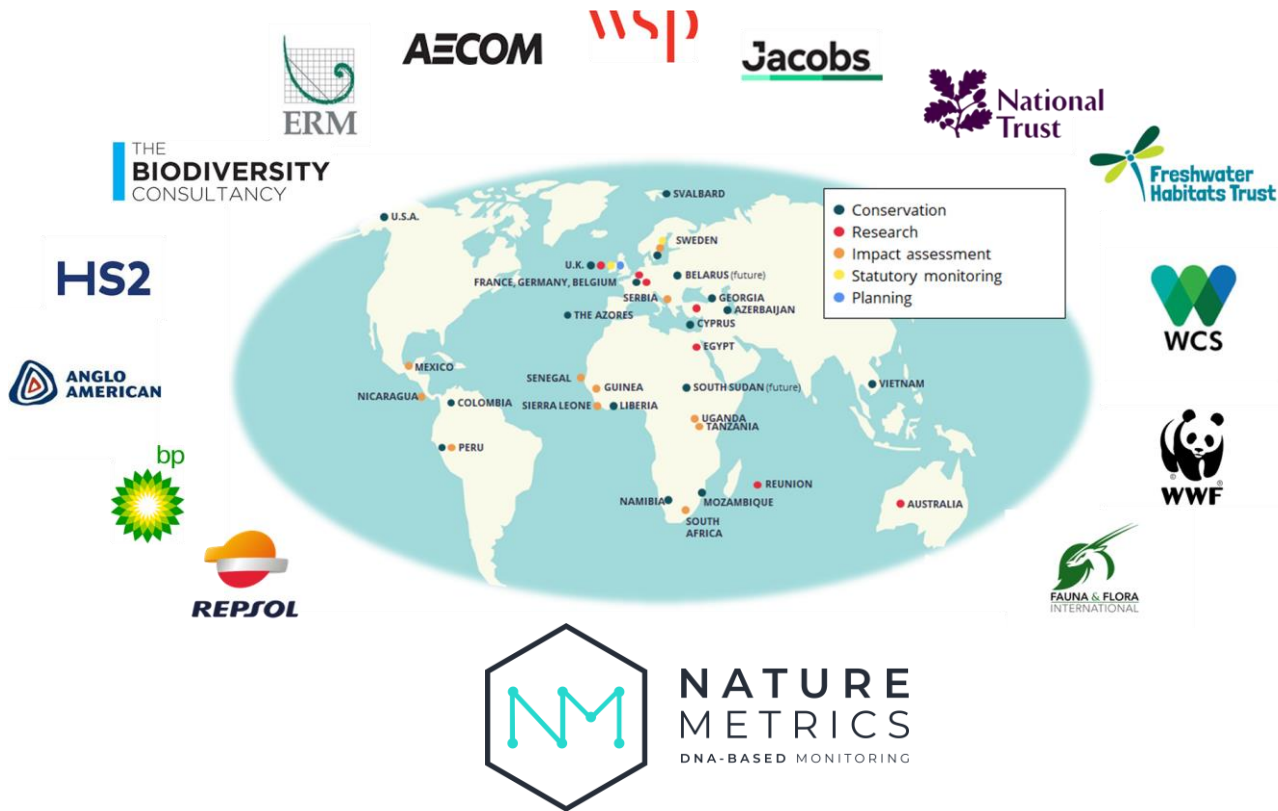
Summarise distribution
of unique sequences
across samples

	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
Sequence 1	1471			
Sequence 2				4973
Sequence 3				16749
Sequence 4				8628
Sequence 5	76713			
Sequence 6				3023
Sequence 7			47851	
Sequence 8	18898	134872		52918
Sequence 9	468	1074	12812	
Sequence 10				4278
Sequence 11		386	10019	729

Match against reference library

Sequence ID	Species	Common name	ID%	SAMPLE 1			SAMPLE 4
Sequence 1	<i>Lota lota</i>	Burbot	100	1471			
Sequence 2	<i>Carassius carassius</i>	Crucian carp	100				4973
Sequence 3	<i>Anguilla anguilla</i>	European eel	100				16749
Sequence 4	<i>Esox lucius</i>	Northern pike	100				8628
Sequence 5	<i>Perca fluviatilis</i>	Perch	100	76713			
Sequence 6	<i>Leucaspis delineatus</i>	Sunbleak	100				3023
Sequence 7	<i>Rana temporaria</i>	Common frog	100			47851	
Sequence 8	<i>Bufo bufo</i>	Common toad	100	18898	134872		52918
Sequence 9	<i>Rana arvalis</i>	Moor frog	100	468	1074	12812	
Sequence 10	<i>Pelophylax lessonae</i> / <i>Rana ridibundus</i>	Pool frog / Edible Frog	100				4278
Sequence 11	<i>Lissotriton vulgaris</i>	Smooth newt	98.256		386	10019	729

good relative
abundance
data



37
STAFF

150+
CLIENTS

10,000+
SAMPLES

The largest specialist eDNA company in the world

eDNA THE NATUREMETRICS WAY

SAMPLING KITS



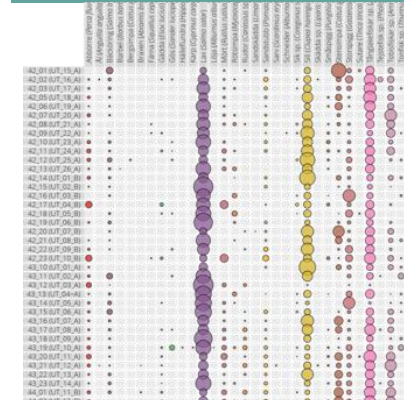
LAB ANALYSIS



BIOINFORMATICS



REPORTING

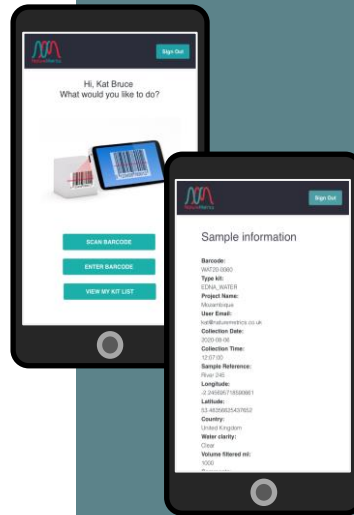


Online ordering & tracking system

eDNA THE NATUREMETRICS WAY



eDNA sampling is carried out by the client, using our custom-designed kits





NATURE
METRICS
DNA-BASED MONITORING



Our vision:

Anyone can collect a high-quality sample, anywhere in the world*

* Experts required for robust sampling design

IN THE FIELD

HARD TO
CONTAMINATE

NO PUMP

REDUCED
CLOGGING

NO NEED
FOR COLD
STORAGE

LOGISTICS
SUPPORT



FILTER



FILTER



PRESERVE



SEND

MOBILE
APP FOR
FIELD DATA

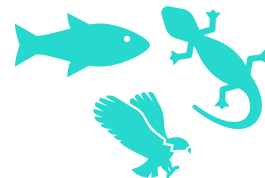
CAN CITIZEN SCIENTISTS COLLECT GOOD DATA WITH eDNA?



Name	Age	Occupation	Wrapped?	Notes
Maia	14	School student	No	Downstream of swimmers
Edwin	19	University student	No	Level with swimmers
Emily	30	Doctor	No	Level with swimmers
Tom	33	Researcher	Yes	Fell in while collecting water
Rozzy	34	Teacher	No	Downstream of swimmers
Mike	44	Chef	Yes	Upstream of swimmers
Jonny	49	Lecturer	No	Level with swimmers
Jane	63	Artist	Yes	Downstream of swimmers

1 sample per
participant

2 samples
from expert



CAN CITIZEN SCIENTISTS COLLECT GOOD DATA WITH eDNA?



	Unwrapped					Wrapped				
	Emily	Jonny	Rozzy	Maia	Edwin	Mike	Tom	Jane	Kat	Kat2
European eel	•	•	•	•	•	•	•	•	•	•
Spined loach	•	•	•	•	•	•	•	•	•	•
Common bream	•	•	•	•	•	•	•	•	•	•
Gudgeon	•	•	•	•	•	•	•	•	•	•
Dace/Orfe	•	•	•	•	•	•	•	•	•	•
Bitterling	•	•	•	•	•	•	•	•	•	•
Roach	•	•	•	•	•	•	•	•	•	•
Chub	•	•	•	•	•	•	•	•	•	•
Tench	•	•	•	•	•	•	•	•	•	•
Stone loach	•	•	•	•	•	•	•	•	•	•
Northern pike	•	•	•	•	•	•	•	•	•	•
Ruffe	•	•	•	•	•	•	•	•	•	•
Perch/Zander	•	•	•	•	•	•	•	•	•	•
European bullhead	•				•	•				
Mallard/Common shelduck	•	•	•	•	•	•	•	•	•	•
Duck species	•	•	•	•	•	•	•	•	•	•
Dove species	•	•	•	•	•	•		•	•	•
Common moorhen	•	•	•			•	•	•	•	•
Grey heron						•				
Water vole	•	•	•	•	•	•	•	•	•	•
Cow	•	•	•	•	•	•			•	•
Dog	•	•	•	•	•	•	•	•	•	•
Human	•	•	•	•	•	•	•	•	•	•

Kat is eDNA
expert

Replicable
relative
abundance
data



NATURE
METRICS
DNA-BASED MONITORING

Save costs by
hiring local
contractors

Sample more
regularly

Engage local
stakeholders



Independent
auditing

	Unwrapped					Wrapped				
	Emily	Jonny	Rozzy	Maia	Edwin	Mike	Tom	Jane	Kat	Kat2
European eel	•	•	•	•	•	•	•	•	•	•
Spined loach	•	•	•	•	•	•	•	•	•	•
Common bream	•	•	•	•	•	•	•	•	•	•
Gudgeon	•	•	•	•	•	•	•	•	•	•
Dace/Orfe	•	•	•	•	•	•	•	•	•	•
Bitterling	•	•	•	•	•	•	•	•	•	•
Roach	•	•	•	•	•	•	•	•	•	•
Chub	•	•	•	•	•	•	•	•	•	•
Tench	•	•	•	•	•	•	•	•	•	•
Stone loach	•	•	•	•	•	•	•	•	•	•
Northern pike	•	•	•	•	•	•	•	•	•	•
Ruffe	•	•	•	•	•	•	•	•	•	•
Perch/Zander	•	•	•	•	•	•	•	•	•	•
European bullhead	•				•	•				
Mallard/Common shelduck	•	•	•	•	•	•	•	•	•	•
Duck species	•	•	•	•	•	•	•	•	•	•
Dove species	•	•	•	•	•	•		•	•	•
Common moorhen	•	•	•			•	•	•	•	•
Grey heron						•				
Water vole	•	•	•	•	•	•	•	•	•	•
Cow	•	•	•	•	•	•	•	•	•	•
Dog	•	•	•	•	•	•	•	•	•	•
Human	•	•	•	•	•	•	•	•	•	•

Replicable
relative
abundance
data

IN THE FIELD



NATURE
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DNA-BASED MONITORING

How does eDNA
compare to
conventional
survey methods?



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HYDROPOWER PROJECT (SWEDEN)



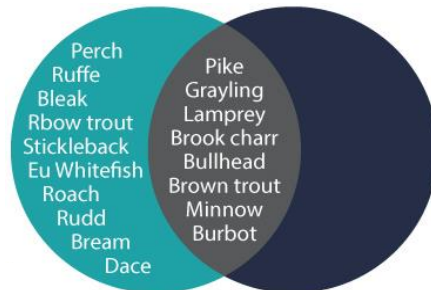
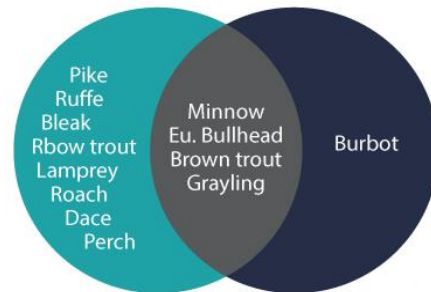
eDNA outperforms
traditional methods



2 days



30 years





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DNA-BASED MONITORING



FISH SURVEYS ON COAST OF SWEDEN

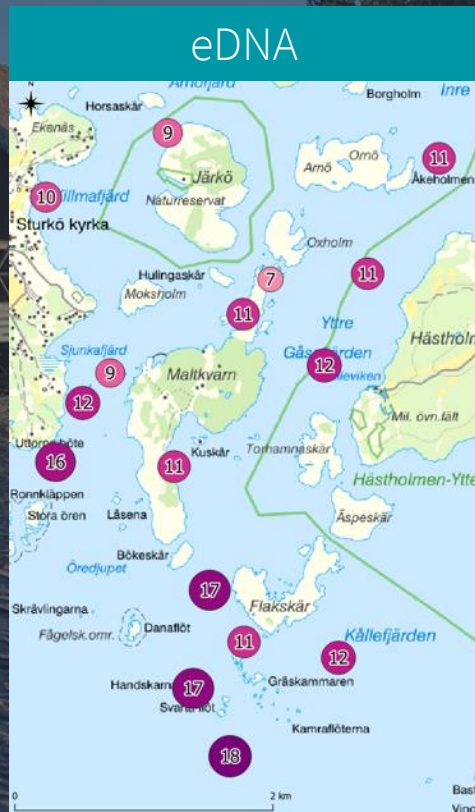
eDNA outperforms
netting in the sea

NETTING



Overnight

eDNA



1 x 3L sample

IN THE UK & EUROPE

eDNA metabarcoding well-validated for fish surveys

Supported by many published scientific studies

Reference libraries are well-developed



THINGS ARE DIFFERENT
IN THE TROPICS



NATURE
METRICS
DNA-BASED MONITORING

LOCAL STAKEHOLDER TRAINING IN LIBERIA

Highly
replicable data

Non-experts
collect high
quality eDNA
samples



Incomplete
reference
libraries

	Group 1	Group 2	Group 3
<i>Epiplatys dageti</i>	●	●	●
<i>Oreochromis niloticus</i>	●	●	●
<i>Oreochromis</i> sp.	·	·	·
Cichlidae sp. 1	·	·	·
Cichlidae sp. 2	●	●	●
Perciformes sp. 1	·	·	·
Perciformes sp. 2	●	●	●
Perciformes sp. 3	·	·	·
Perciformes sp. 4	·	·	·
Perciformes sp. 5	·	·	·
Perciformes sp. 6	●	●	●
<i>Polypterus palmas</i>	●	●	●
<i>Clarias</i> cf. <i>buettikoferi/laeviceps/salae</i>	·	·	·
Siluriformes sp. 1	·	·	·
Siluriformes sp. 2	·	·	·
<i>Hoplobatrachus</i> cf. <i>occipitalis</i>	·	·	·
<i>Hyperolius</i> sp.	■	·	·
<i>Dendrocygna</i> sp.	·	·	■



**NATURE
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DNA-BASED MONITORING

EIA PROJECT IN WEST AFRICA



We can help
build up local
reference
libraries

OTU_ID	Class	Order	Family	Genus	Species	Similarity	Fin clip reference	Red List	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
OTU299	Actinopterygii	Cyprinodontiformes	Poeciliidae	<i>Rhexipanchax</i>							15064			4596	359	
OTU285	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Marcusenius</i>							21	1574			264	
OTU282	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Mormyrops</i>								769		1491		40
OTU262	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Petrocephalus</i>						3245	7906	16966		119	9501	4686
OTU44	Actinopterygii	Osteoglossiformes	Mormyridae									38814	37		450	159
OTU385	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>										33541		47
OTU55	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>								4659		2172		
OTU223	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>								413		660		
OTU338	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>								115				
OTU77	Actinopterygii	Perciformes	Cichlidae	<i>Oreochromis</i>												
OTU362	Actinopterygii	Perciformes	Cichlidae	<i>Oreochromis</i>						587			61	466		
OTU267	Actinopterygii	Perciformes	Cichlidae	<i>Tilapia</i>						38765		185		91	82	282
OTU229	Actinopterygii	Perciformes	Cichlidae	<i>Tilapia</i>						6947		50				39
OTU324	Actinopterygii	Perciformes	Cichlidae											4648		
OTU268	Actinopterygii	Siluriformes	Amphiliidae	<i>Amphilius</i>						862	17352	2170	339	934	6254	7729
OTU286	Actinopterygii	Siluriformes	Amphiliidae	<i>Doumea</i>							311	1633	134	3381	1262	
OTU269	Actinopterygii	Siluriformes	Clariidae	<i>Clarias</i>						3182	17181	3729	639	3437	6602	29245



NATURE
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DNA-BASED MONITORING

EIA PROJECT IN WEST AFRICA



Species genetic barcodes



We can help
build up local
reference
libraries

New names
added to this
dataset as
libraries grow

OTU_ID	Class	Order	Family	Genus	Species	Similarity	Fin clip reference	Red List	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
OTU299	Actinopterygii	Cyprinodontiformes	Poeciliidae	<i>Rhexipanchax</i>	<i>Rhexipanchax nimbaensis</i>	100.0	NMID7288_Rhexipanchax_nimbaensis_AR19	Vulnerable			15064			4596	359	
OTU285	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Marcusenius</i>							21	1974			264	
OTU282	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Mormyrops</i>	<i>Mormyrops anguilloides</i>	100.0		Least Concern				769		1491		40
OTU262	Actinopterygii	Osteoglossiformes	Mormyridae	<i>Petrocephalus</i>	<i>Petrocephalus pellegrini</i>	100.0	NMID7286_Petrocephalus_pellegrini_SW01	Least Concern		3245	7906	16966		119	9501	4686
OTU44	Actinopterygii	Osteoglossiformes	Mormyridae									38814	37		450	159
OTU385	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>	<i>Hemichromis bimaculatus</i>	100.0	NMID7297_Hemichromis_bimaculatus_AR61_3	Least Concern						33541		47
OTU55	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>	<i>Hemichromis bimaculatus</i> sp.2	100.0	NMID7291_Hemichromis_bimaculatus_AR61	Least Concern				4659		2172		
OTU223	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>	<i>Hemichromis fasciatus</i>	100.0	NMID7293_Hemichromis_fasciatus_AR61	Least Concern				413		660		
OTU338	Actinopterygii	Perciformes	Cichlidae	<i>Hemichromis</i>							115					
OTU77	Actinopterygii	Perciformes	Cichlidae	<i>Oreochromis</i>												
OTU362	Actinopterygii	Perciformes	Cichlidae	<i>Oreochromis</i>		100.0	NMID7303_Oreochromis_sp_AR23	Least Concern		587			61	466		
OTU267	Actinopterygii	Perciformes	Cichlidae	<i>Tilapia</i>	<i>Tilapia zillii</i>	100.0	NMID7307_Tilapia_zillii_AR15	Least Concern		38765		185		91	82	282
OTU229	Actinopterygii	Perciformes	Cichlidae	<i>Tilapia</i>						6947		50				39
OTU324	Actinopterygii	Perciformes	Cichlidae											4648		
OTU268	Actinopterygii	Siluriformes	Amphiliidae	<i>Amphilius</i>	<i>Amphilius atesuensis</i>	100.0	NMID7281_NMID7298_Amphilius_atesuensis	Least Concern		862	17352	2170	339	934	6254	7729
OTU286	Actinopterygii	Siluriformes	Amphiliidae	<i>Doumea</i>	<i>Doumea chappuisi</i>	100.0	NMID7283_NMID7301_Doumea_chappuisi	Vulnerable			311	1633	134	3381	1262	
OTU269	Actinopterygii	Siluriformes	Clariidae	<i>Clarias</i>	<i>Clarias cf. buettikoferi</i>	100.0	NMID7300_Clarias_cf_buettikoferi_AR23	Least Concern		3182	17181	3729	639	3437	6602	29245



NATURE
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DNA-BASED MONITORING

VERTEBRATE BASELINE IN PERUVIAN AMAZON



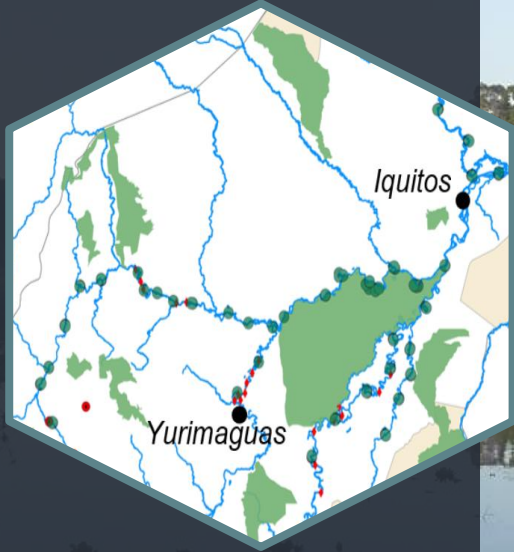
TARGET
SPECIES:

PINK
RIVER DOLPHIN

AMAZON MANATEE



NATURE
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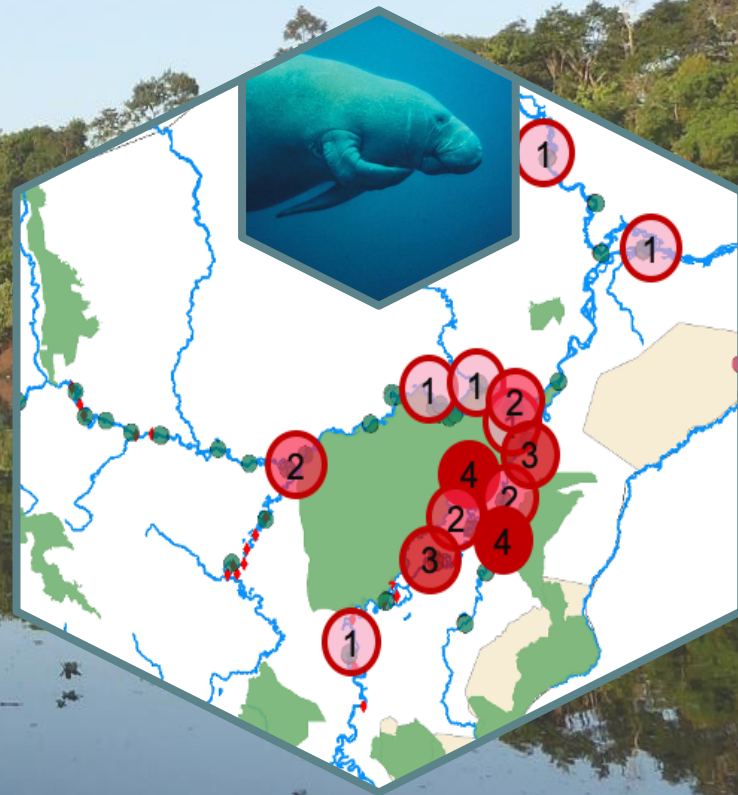
4 x 500 ml samples
at each of 40 locations



12S
VERTEBRATES



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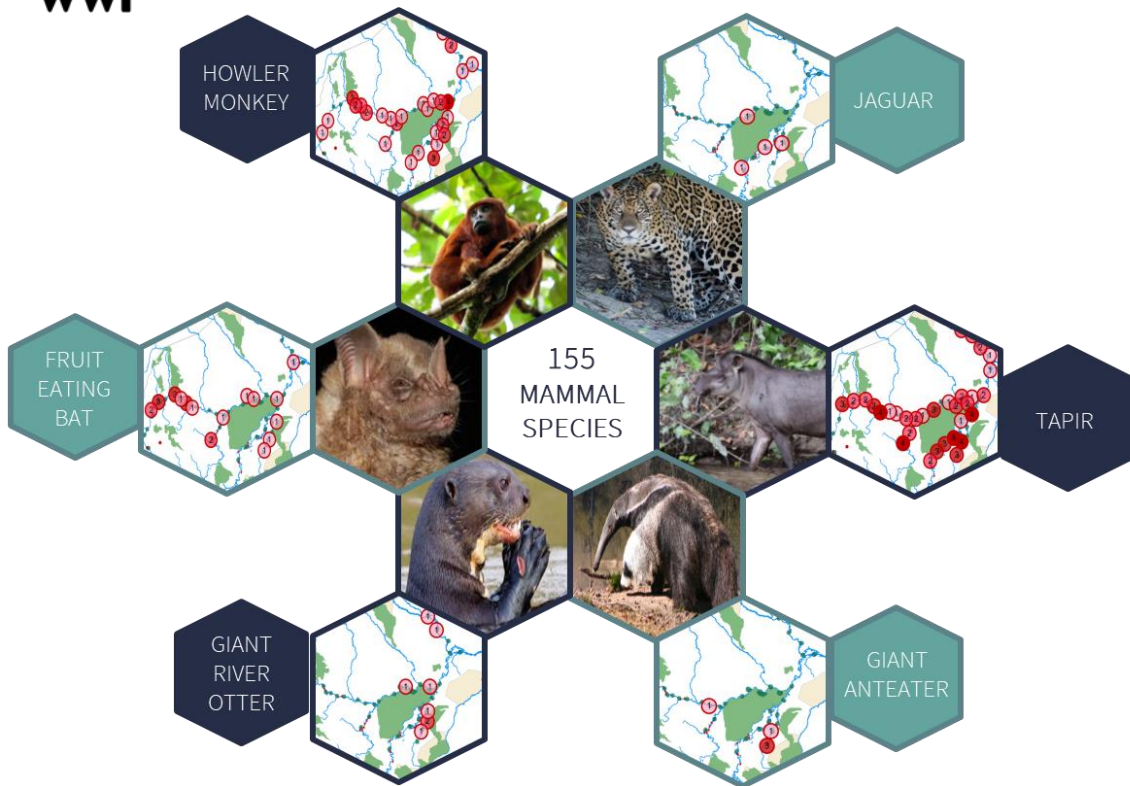




**NATURE
METRICS**
DNA-BASED MONITORING

Group	Species
Fish	375
Mammals	155
Amphibians	74
Reptiles	6
Birds	65

675
VERTEBRATE SPECIES

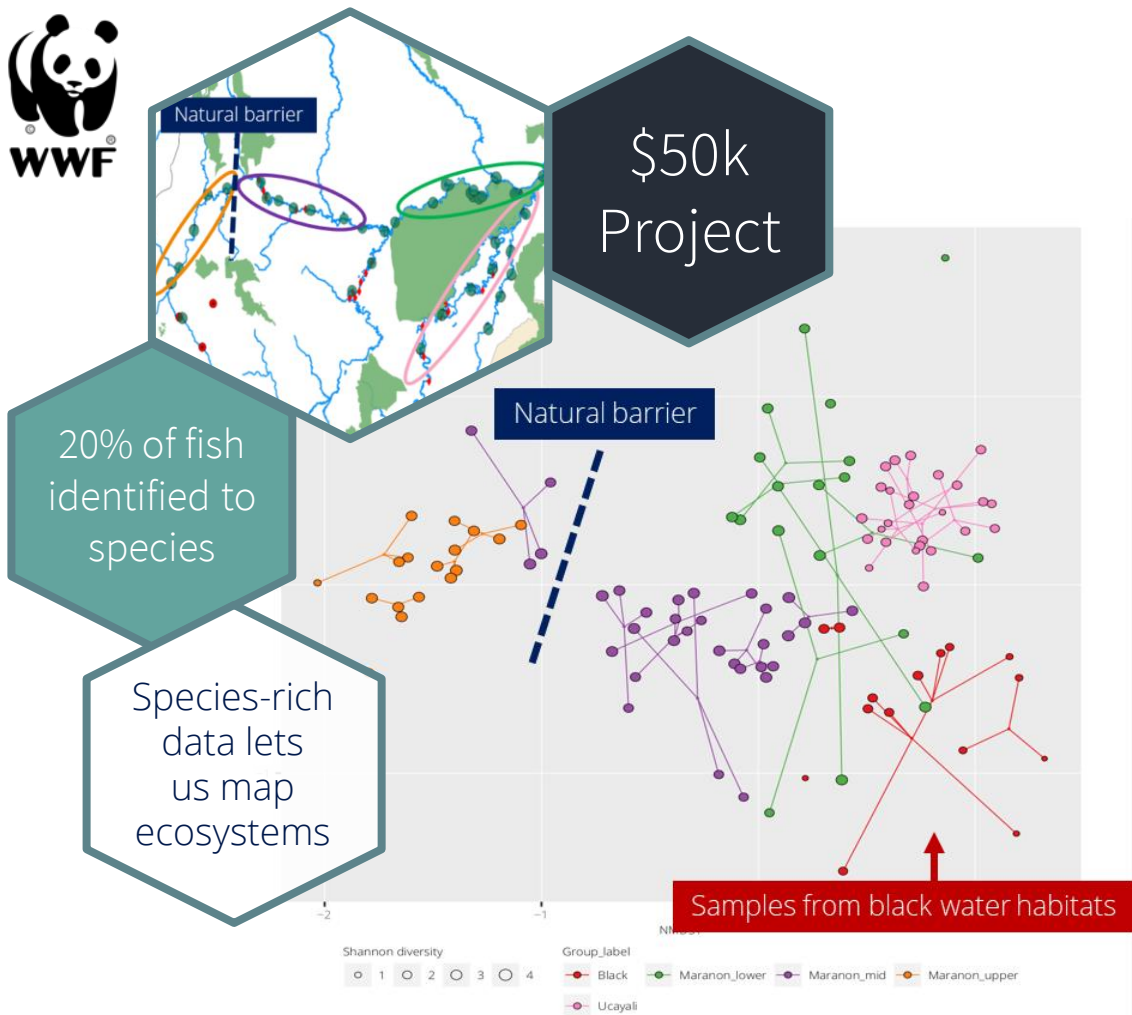


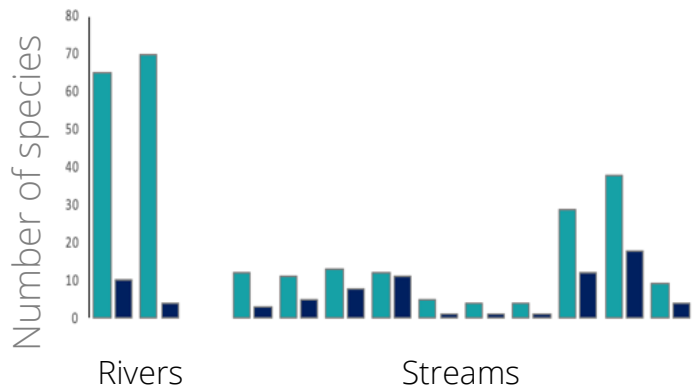
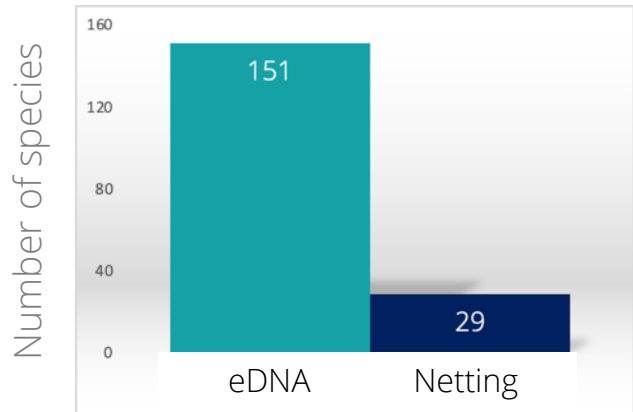


NATURE
METRICS
DNA-BASED MONITORING

Group	Species
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675
VERTEBRATE SPECIES

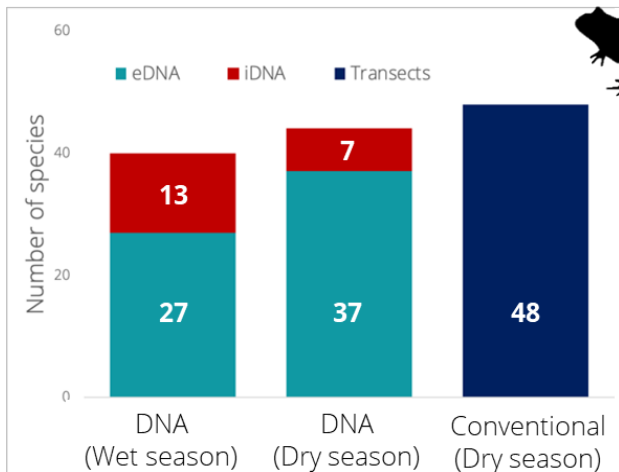
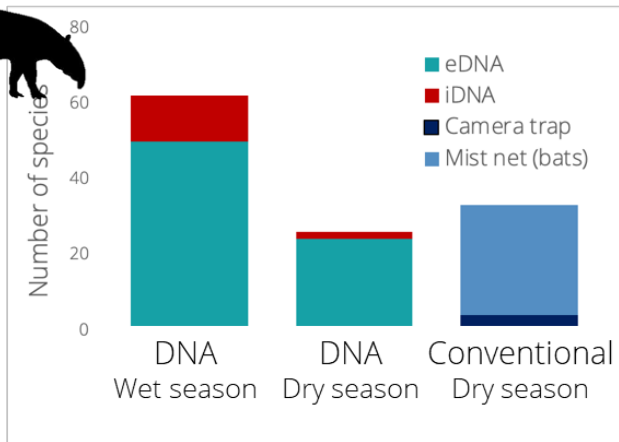




NATURE
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DNA-BASED MONITORING

METHODS COMPARISON FOR IMPACT ASSESSMENT IN PERU





NATURE
METRICS
DNA-BASED MONITORING

METHODS COMPARISON FOR IMPACT ASSESSMENT IN PERU

Data on all groups
derived from the same
samples.

No dedicated sampling
effort for amphibians,
mammals or birds

\$12k
Project



Class	Species name	Common name	IUCN status
Birds	<u>Eupherusa poliocerca</u>	White-tailed hummingbird	VU
Birds	<u>Penelopina nigra</u>	Highland Guan	VU
Birds	<u>Psophia crepitans</u>	Grey-winged Trumpeter	NT
Birds	<u>Ramphastos tucanus</u>	Red-billed Toucan	VU
Mammals	<u>Lontra longicaudis</u>	Neotropical Otter	NT
Mammals	<u>Inia geoffrensis</u>	Amazon River Dolphin	EN
Mammals	<u>Priodontes maximus</u>	Giant armadillo	VU
Mammals	<u>Tapirus terrestris</u>	Lowland Tapir	VU
Mammals	<u>Myrmecophaga tridactyla</u>	Giant Anteater	VU
Mammals	<u>Aotus nancymae</u>	Nancy Ma's night monkey	VU
Mammals	<u>Cebus albifrons</u>	Humboldt's White Headed Capuchin	NT
Reptiles	<u>Chelonoidis denticulatus</u>	Yellow-Footed Tortoise	VU

12 red listed species detected with eDNA
Not detected using traditional methods

METHODS COMPARISON FOR IMPACT ASSESSMENT IN PERU

Data on all groups
derived from the same
samples.

No dedicated sampling
effort for amphibians,
mammals or birds

eDNA is a powerful tool that can be used by people all over the world



THANK YOU FOR LISTENING



Email

Send our team an email at
edna-lab@naturemetrics.co.uk



Phone

Call our head office:
Enquiries: [0203 8767350](tel:02038767350)
Technical: [01491 829042](tel:01491829042)



Website

Discover more at
www.naturemetrics.co.uk