Conference_Logo_EN.png

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LIVING DATA 2025

Environmental DNA Expeditions in UNESCO marine World Heritage sites

A citizen science initiative

eDNA expeditions was a citizen science initiative that empowered local communities to sample their World Heritage sites with cutting edge eDNA methods.

A collaboration between OBIS and the World heritage marine program, the project provided about 20 citizen science sampling kits for each site, comprised of a syringe, filter, and preservation liquid.

Data was registered using a sampling smartphone application, through which also pictures and sampling selfies could also be uploaded.

Project objectives

- ✓ **Provide a one-off biodiversity snapshot**, (of fish and other priority species) in UNESCO World Heritage marine sites, using a shared eDNA methodology
- ✓ **Test and refine a simple eDNA sampling protocol for citizen scientists** and demonstrate its use in biodiversity monitoring across various environmental and socio-economic settings
- ✓ **Promote open science** by making all data, tools, and protocols freely accessible for global use
- ✓ **Estimate climate change impacts** by identifying species' thermal limits and assessing their vulnerability to rising temperatures

Why eDNA?

Opportunities and challenges

- ✓ **Standardised biodiversity monitoring**
  - ✓ Due to the simple sampling protocols, eDNA has the potential to revolutionize how we detect (“see”) biodiversity
- ✓ **Non-invasive, repeatable and accessible sampling**
- ✓ **However: only presence – absence detections**
- ✓ Useful for specific purposes like:
  - ✓ Large-scale surveys on species presence -> help define targets
  - ✓ Detection of rare or invasive species (specific targets)
- ✓ **Major remaining challenge:**
  - ✓ Lack of species in the reference databases cause issues in identification
  - ✓ Can be fixed, by further barcoding work!

21 participating World Heritage marine sites

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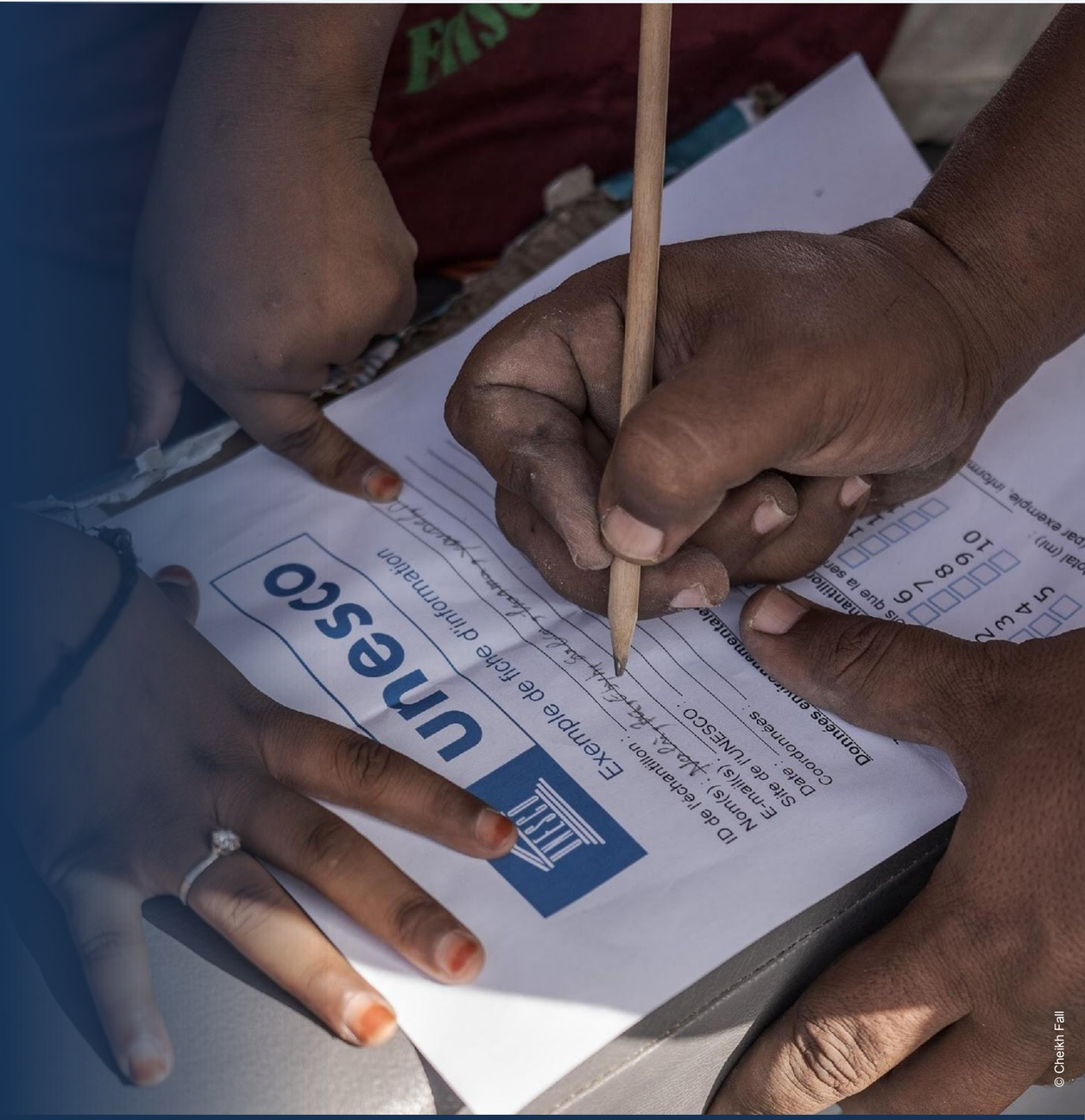
Results

- ✓ 21 World Heritage sites have joined the initiative
- ✓ Sampling conducted between September 2022 and May 2023
- ✓ 550 eDNA kits shipped
- ✓ Over 100 video calls including training
- ✓ 200 citizen scientists collected eDNA samples
- ✓ 1st media campaign (context COP15) generated an estimated impressions of 76,273,433 (including broadcast viewership, social media tweets and retweets)



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Impressions

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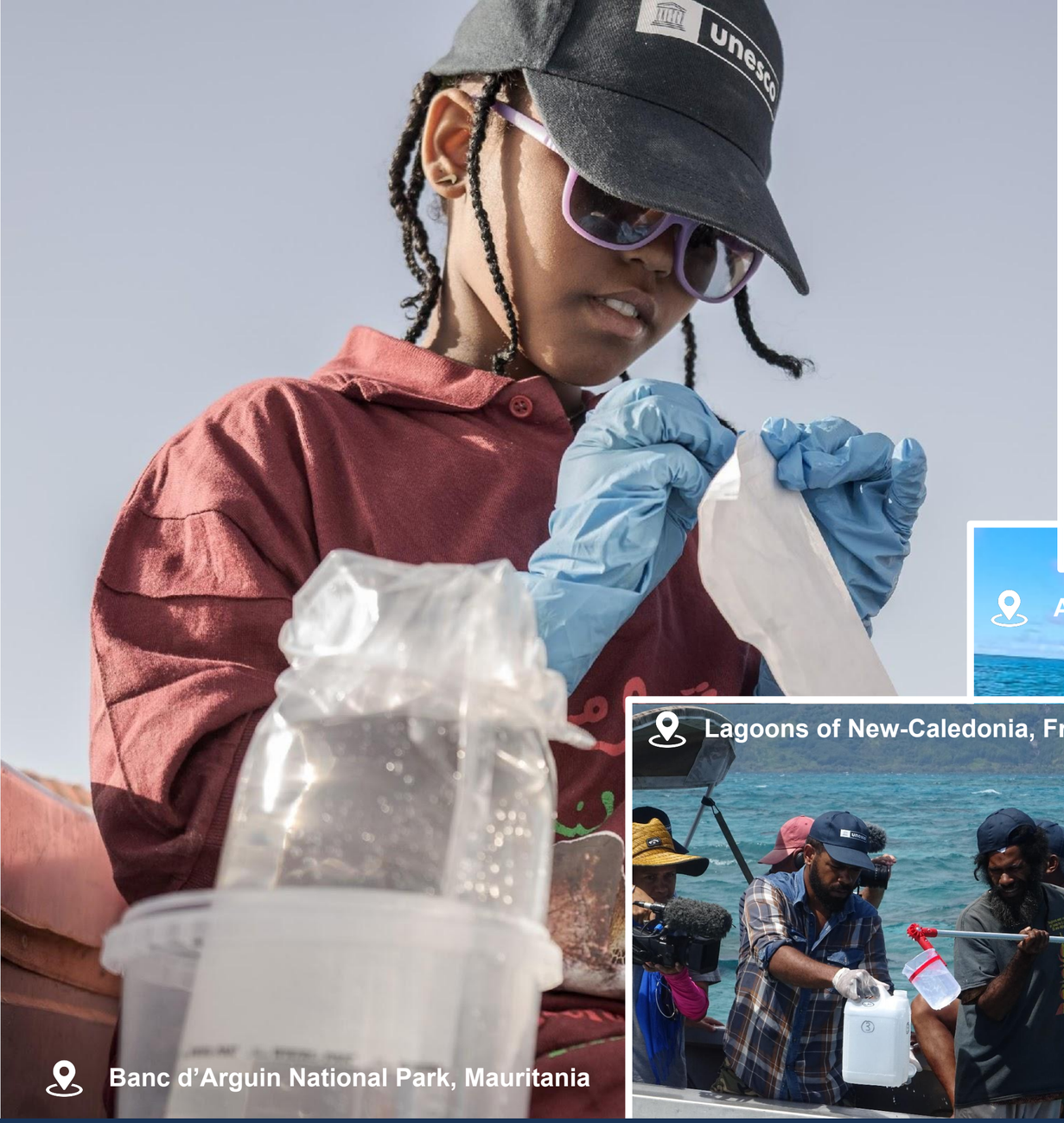
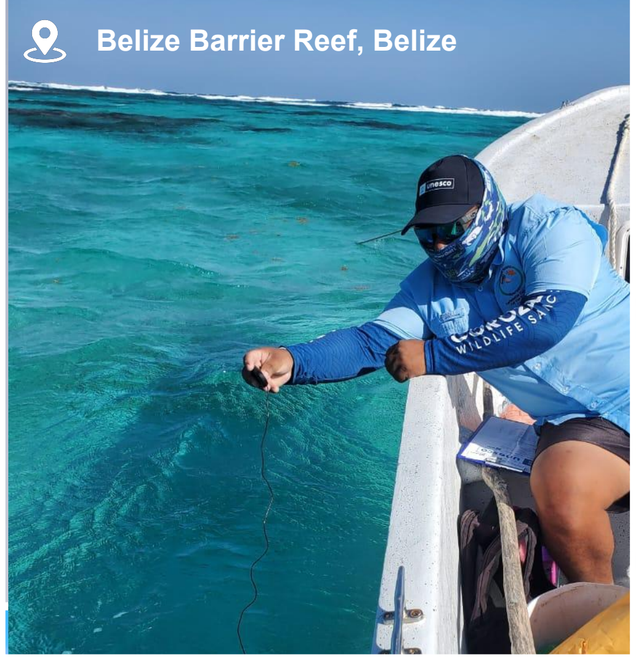
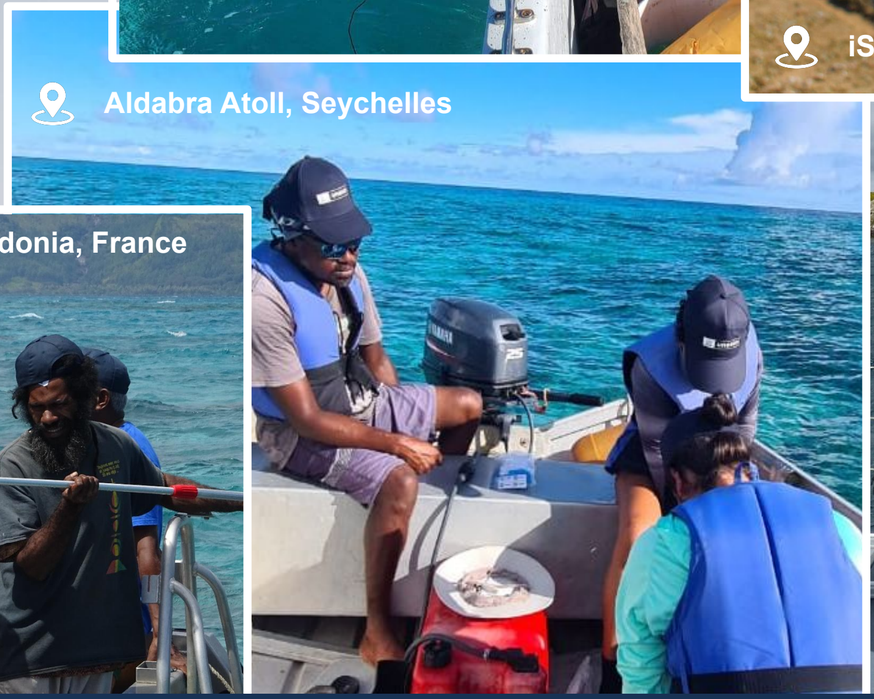


Banc d’Arguin National Park, Mauritania



Belize Barrier Reef, Belize

iSimangaliso, South Africa



Aldabra Atoll, Seychelles

Lagoons of New-Caledonia, France

French Austral Lands, France

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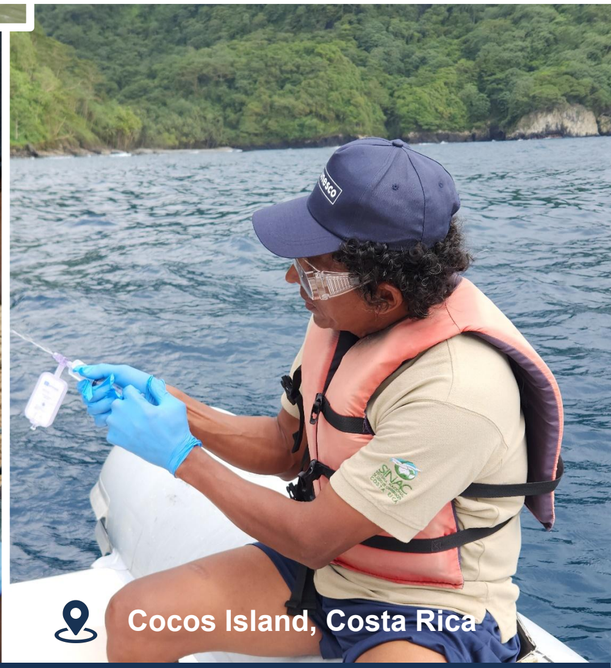
Tubbataha, Philippines


The Sundarbans, Bangladesh


Fernando de Noronha, Brazil


Lord Howe, Australia


Cocos Island, Costa Rica

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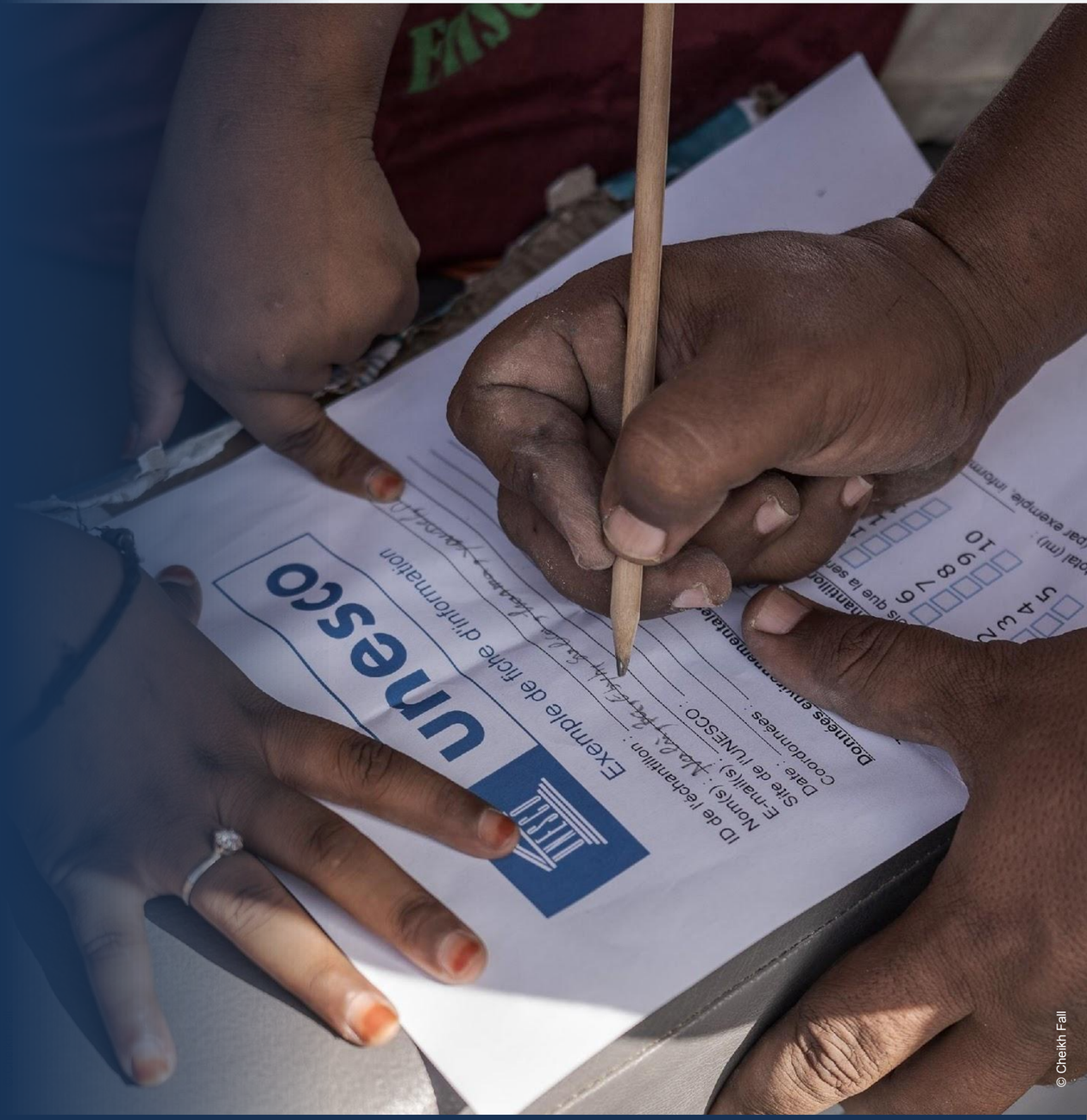
Results

- ✓ 432 samples received out of which
- ✓ 396 samples successfully sequenced

- ✓ 600 million sequences
- ✓ 450 000 unique sequences

- ✓ Major developments made to the PacMAN bioinformatics pipeline based on the work done in this project, and
- ✓ Prompted development of more comprehensive taxonomic review workflows (in progress).



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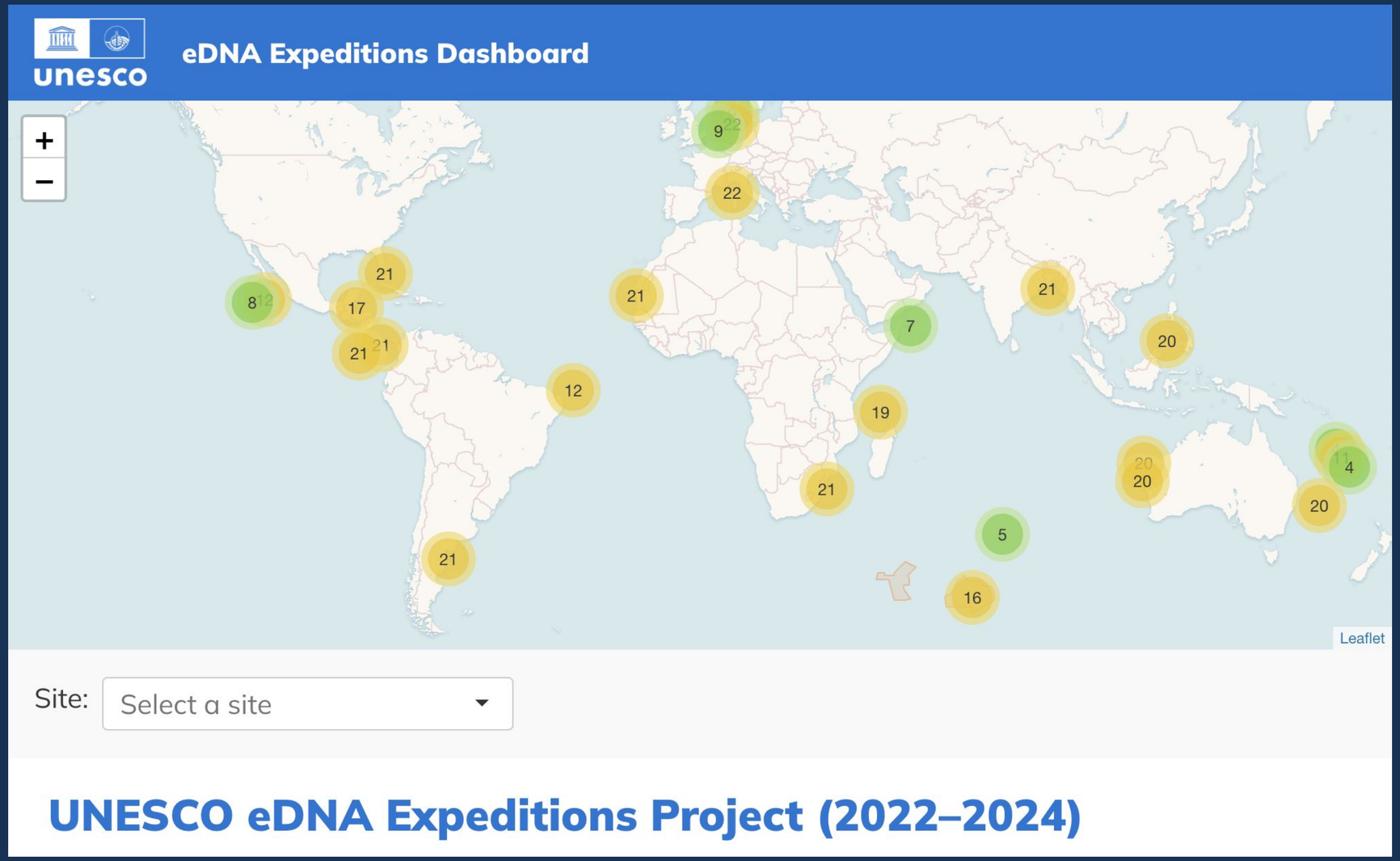
eDNA expeditions dashboard

https://dashboard.ednaexpeditions.org/

- ✓ Discover the species data from each site
- ✓ Over 4406 species identified!
  - ✓ 2078 fish
  - ✓ 120 threatened species
- ✓ Species review done based on qc and local feedback, but
  - ✓ More feedback possible and welcome!



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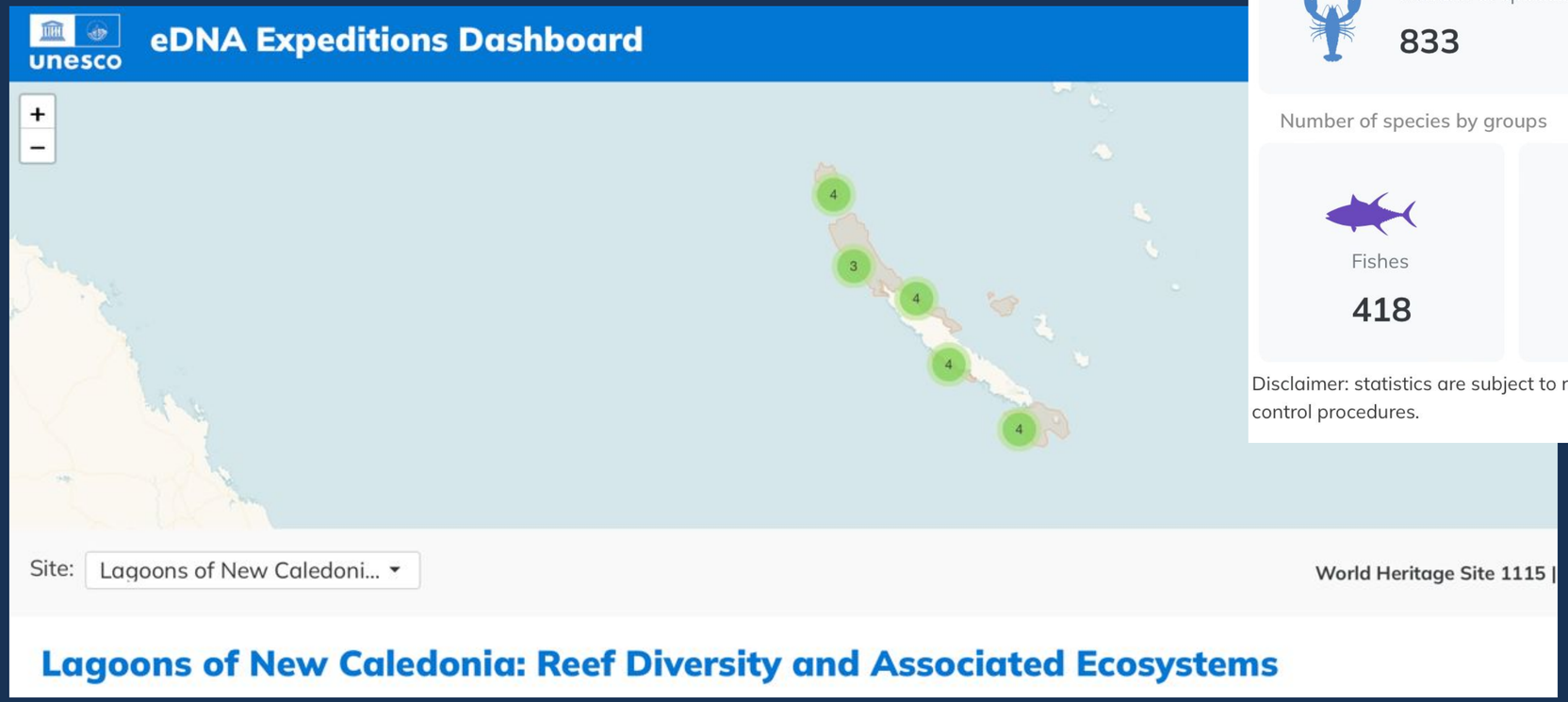
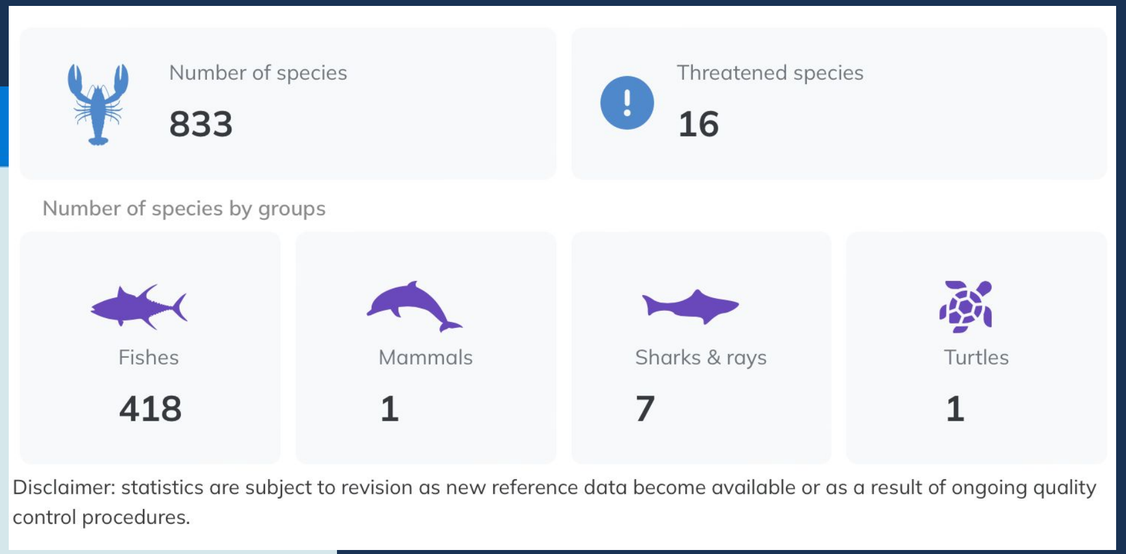
eDNA expeditions overview

https://dashboard.ednaexpeditions.org/

- ✓ Most species in New Caledonia





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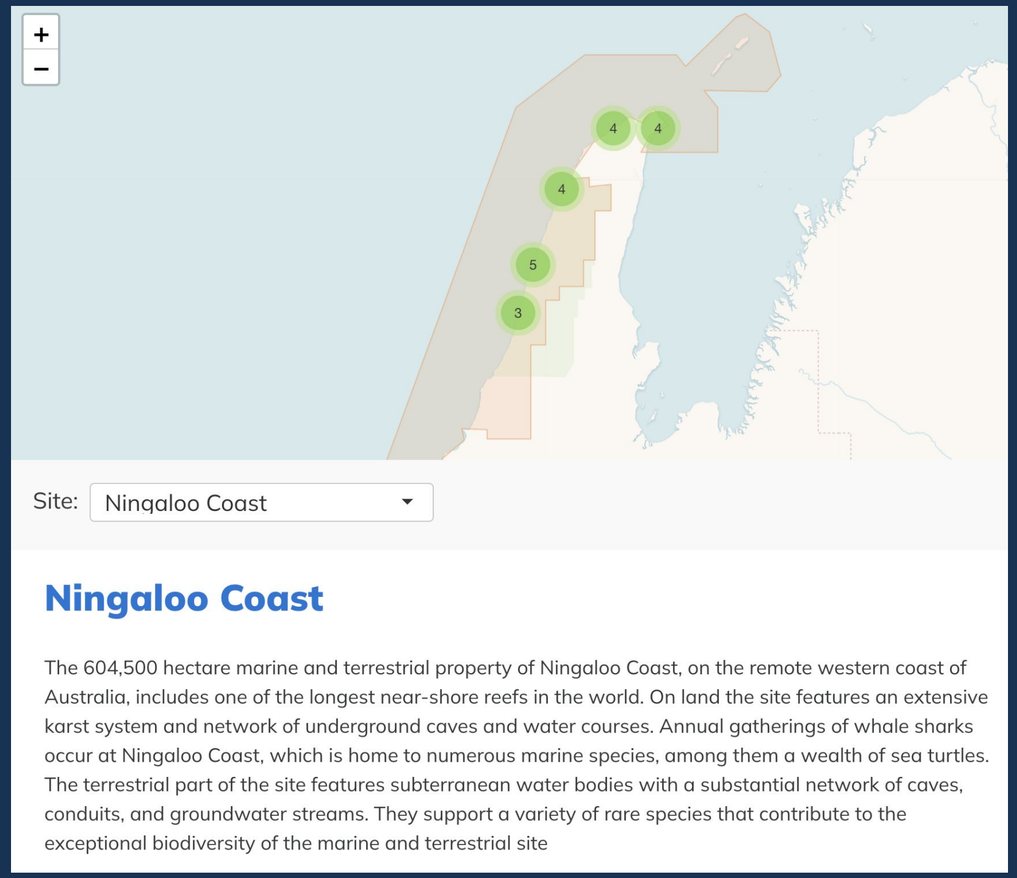
eDNA expeditions overview

https://dashboard.ednaexpeditions.org/

- ✓ Most species of sharks and most red list species in Ningaloo



Ningaloo Coast

The 604,500 hectare marine and terrestrial property of Ningaloo Coast, on the remote western coast of Australia, includes one of the longest near-shore reefs in the world. On land the site features an extensive karst system and network of underground caves and water courses. Annual gatherings of whale sharks occur at Ningaloo Coast, which is home to numerous marine species, among them a wealth of sea turtles. The terrestrial part of the site features subterranean water bodies with a substantial network of caves, conduits, and groundwater streams. They support a variety of rare species that contribute to the exceptional biodiversity of the marine and terrestrial site

Number of species
773

Threatened species
24

Number of species by groups

Fishes	Mammals	Sharks & rays	Turtles
340	1	26	1

Disclaimer: statistics are subject to revision as new reference data become available or as a result of ongoing quality control procedures.

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eDNA expeditions overview

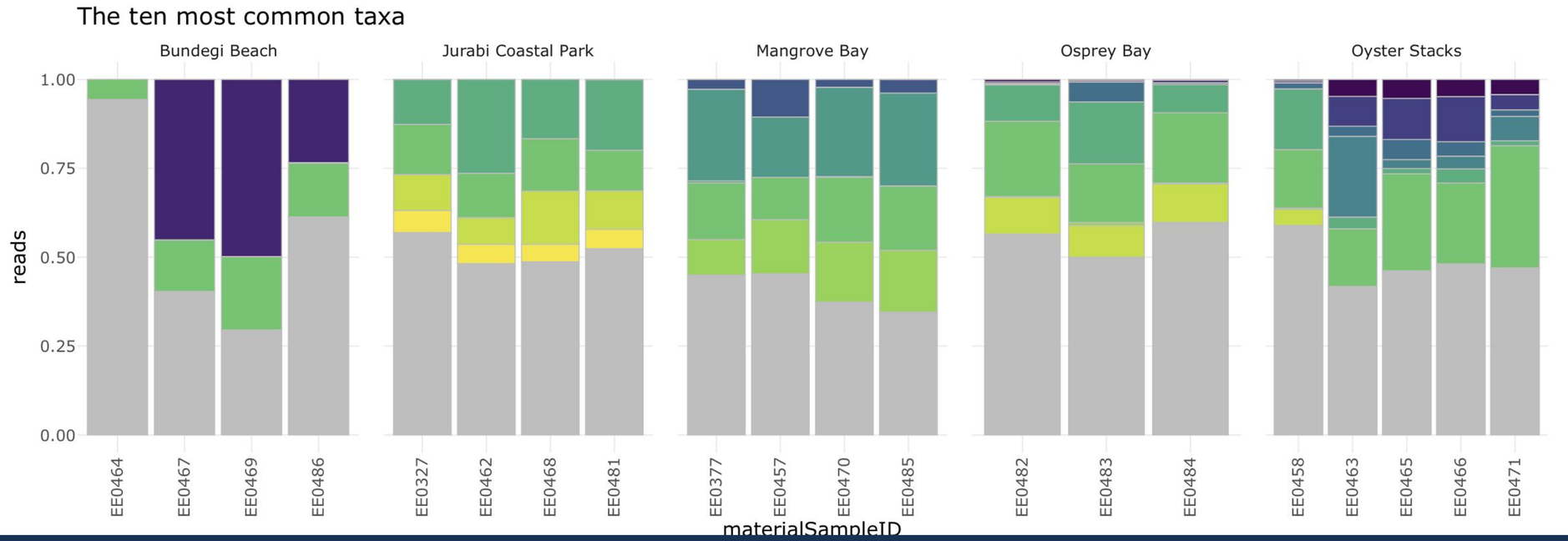
https://dashboard.ednaexpeditions.org/

- ✓ Still many DNA sequences could not be resolved to species

Ningaloo Coast

Diversity metrics

This figure shows the number of sequences (also called reads) in each sample after filtering for quality control, both as absolute numbers as well in relative abundance of the total reads. All sequences that received names are colored, the grey area therefore shows reads that could not be resolved to a taxonomic name. You can toggle the taxonomic level that is shown. At each taxonomic level the top 10 most observed taxa receive a distinct color. Note that contaminations from humans, bacteria (and other prokaryotes), fungi and domestic animals have been removed prior to the analysis.



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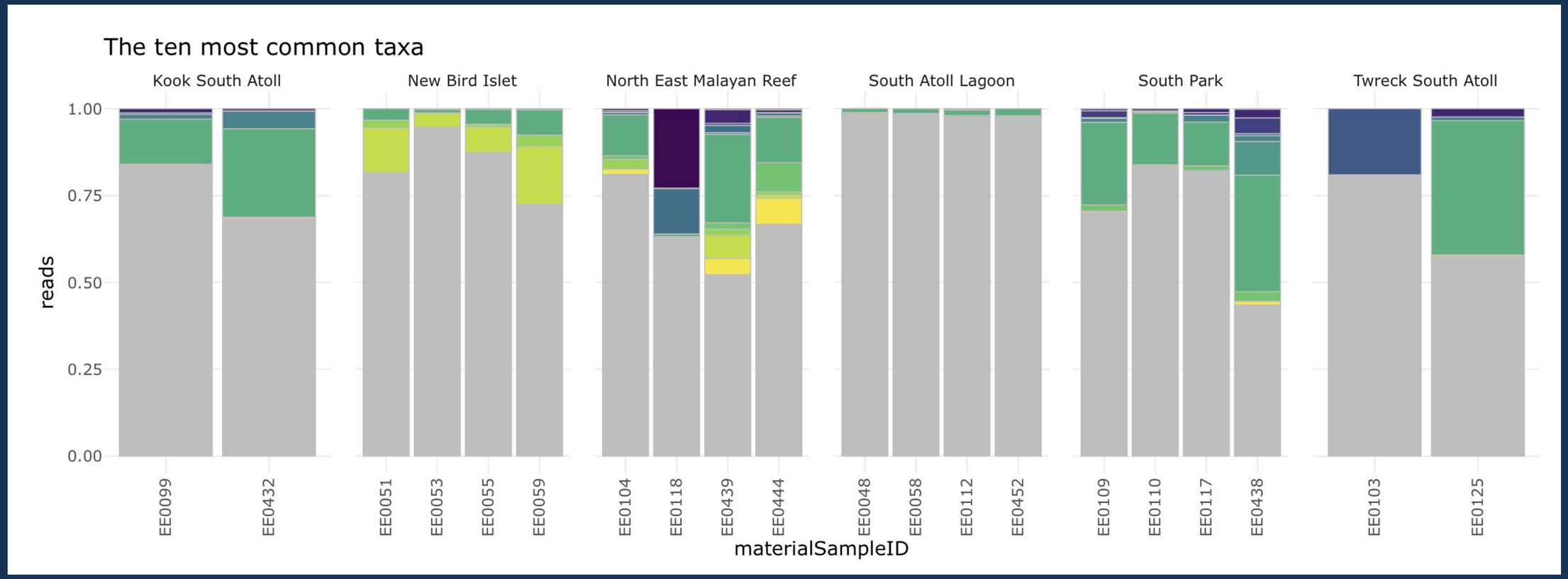
eDNA expeditions overview

https://dashboard.ednaexpeditions.org/

- ✓ Still many DNA sequences could not be resolved to species

Tubbataha Reefs Natural Park



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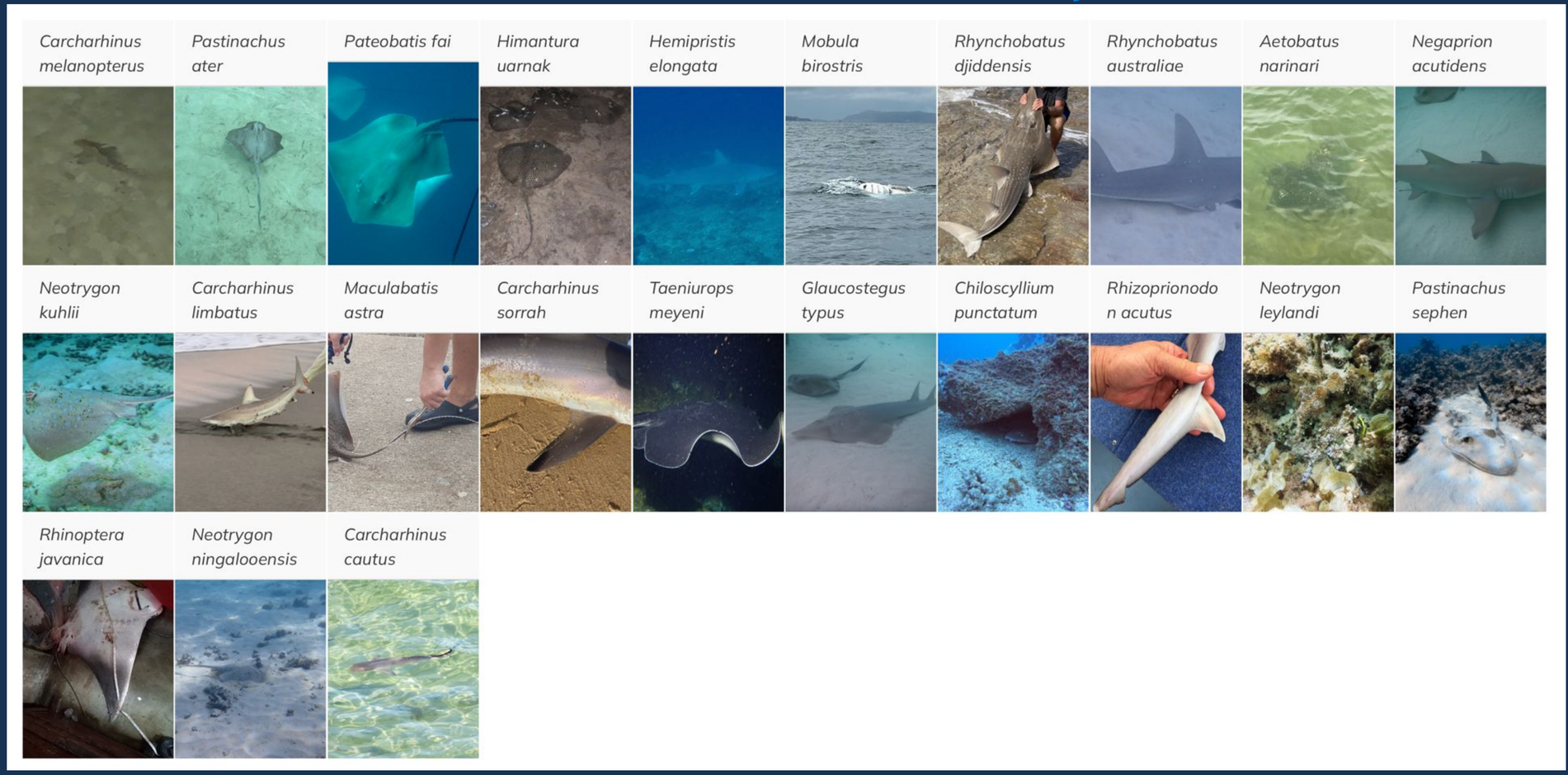
https://dashboard.ednaexpeditions.org/

eDNA expeditions overview: climate

✓ 23 sharks and rays in Shark Bay

Shark Bay



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https://dashboard.ednaexpeditions.org/

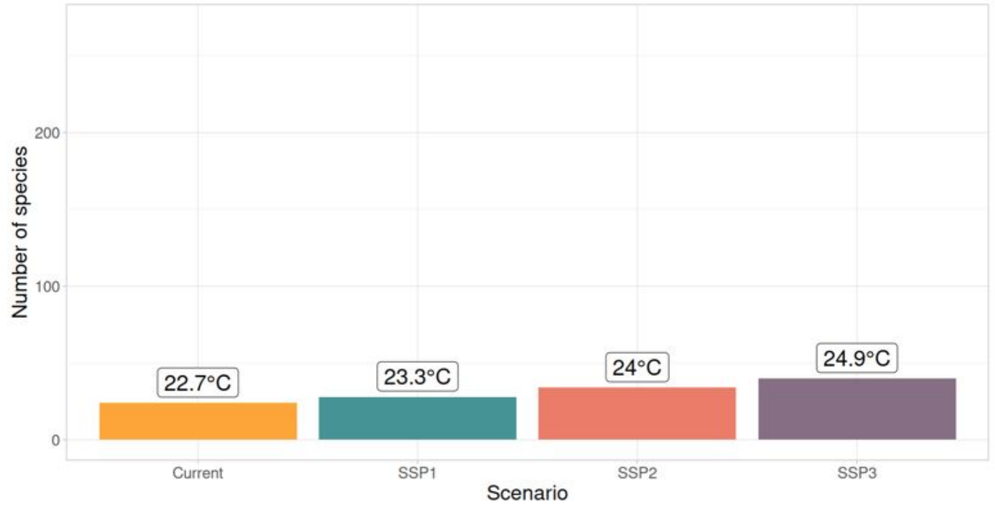
eDNA expeditions overview: climate

✓ Modelled thermal risk in Shark Bay minimal

Shark Bay

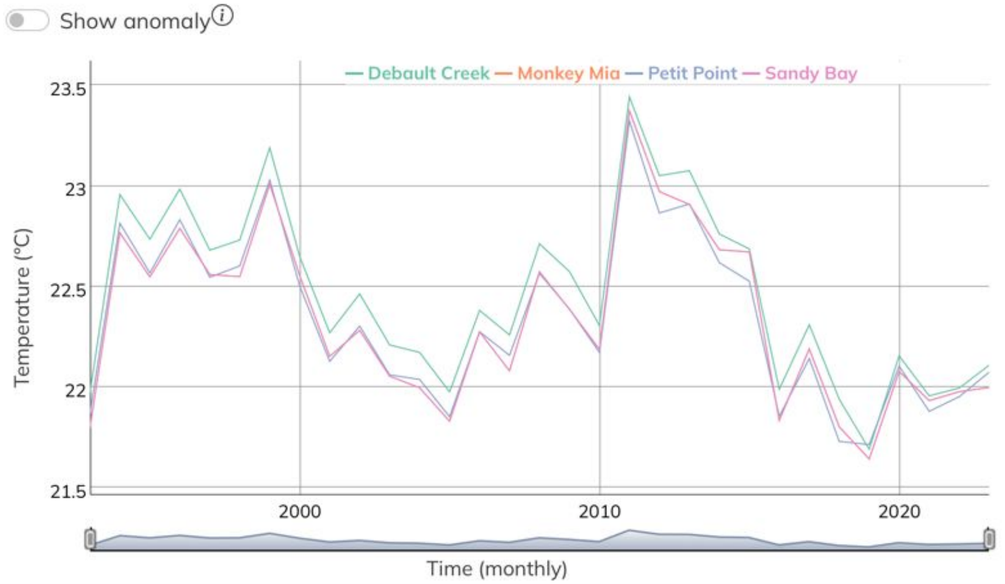
Number of species at thermal risk

The graph shows the number of species at thermal risk for this site under current conditions and three future SSP (shared socio-economic pathways) climate scenarios for 2100. Thermal risk occurs when the site's temperature exceeds a species' thermal limit, defined as the 95th percentile of temperatures where the species has been recorded. Some species, especially in tropical areas, may already exceed this limit. While not indicating local extinction, thermal risk indicates stressful conditions to the organism that may affect its survival. Values at the top of the bars indicate the average SST for the site during that period.



Monthly temperature (degrees Celsius) at the site

The graph shows monthly sea temperature trends for different sites, with an option to display data as anomalies compared to a baseline. Each line represents a site, showing seasonal changes and differences between locations. When using anomalies, the graph highlights periods that are warmer or cooler than usual. This helps to understand temperature patterns and possible climate impacts at each site.



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https://dashboard.ednaexpeditions.org/

eDNA expeditions overview: climate

✓ Modelled thermal risk in Belize is very high

Belize

Number of species at thermal risk

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Monthly temperature (degrees Celsius) at the site

The graph shows monthly sea temperature trends for different sites, with an option to display data as anomalies compared to a baseline. Each line represents a site, showing seasonal changes and differences between locations. When using anomalies, the graph highlights periods that are warmer or cooler than usual. This helps to understand temperature patterns and possible climate impacts at each site.

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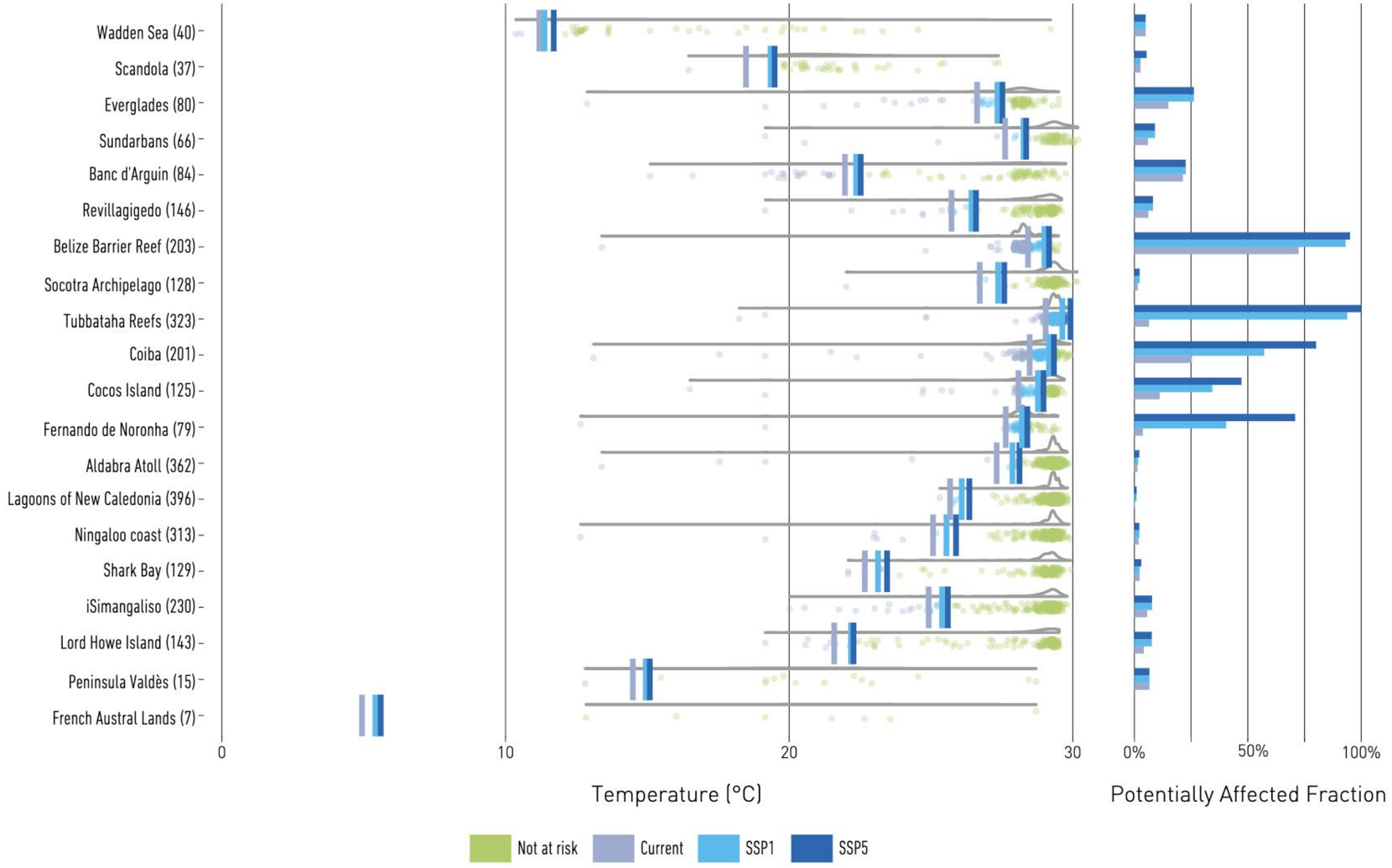
eDNA expeditions overview: climate

- ✓ Thermal risk in tropical sites high
- ✓ We don’t yet know how and if species can adapt

Figure 2: Distribution of upper temperature limits for species detected by eDNA sampling across UNESCO World Heritage marine sites, sorted by latitude (Northern Hemisphere at the top, Southern Hemisphere at the bottom).



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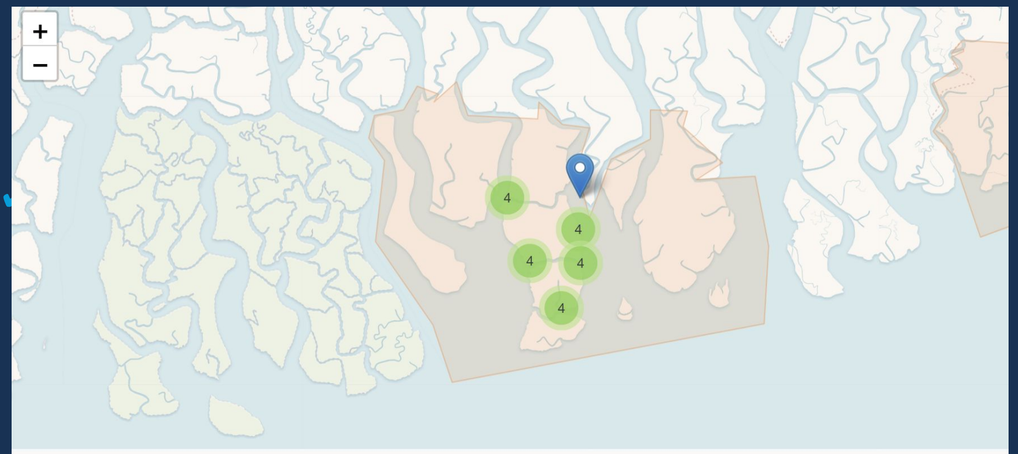
eDNA expeditions overview: globally rare species

- ✓ Most rare species but locally common



Site: The Sundarbans

The Sundarbans

The Sundarbans mangrove forest, one of the largest such forests in the world (140,000 ha), lies on the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. It is adjacent to the border of India’s Sundarbans World Heritage site inscribed in 1987. The site is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests, and presents an excellent example of ongoing ecological processes. The area is known for its wide range of fauna, including 260 bird species, the Bengal tiger and other threatened species such as the estuarine crocodile and the Indian python.

Samples	Localities	Target gene	Reads	RDP confiden...	VSEARCH ide...	NCBI ID	DNA sequence
EE0347	Sundarban west wi...	16S	11	NA		NA	
EE0350,EE0330,EE...	Sundarbans West ...	12S	1793	0.96,0.95	98.8,98.8,98.8...	MZ351458	
EE0350,EE0362,EE...	Sundarbans West ...	12S	200	0.92	98.8,98.8,98.8...	MZ351458	
EE0331,EE0362,EE...	Sundarban west wi...	12S	116	0.99	100,100,100,1...	MZ351458	
EE0331,EE0350,EE...	Sundarban west wi...	12S	497	0.97	99.3,99.3,99.3...	MZ351458	
EE0331,EE0334,EE...	Sundarban west wi...	12S	282	1	99.4,99.4,99.4...	MZ351458	
EE0347,EE0345,EE...	Sundarban west wi...	12S	259	1	99.4,99.4,99.4	MZ351458	

1–7 of 27 rows

Previous 1 2 3 4 Next

Irrawaddy dolphin in the Philippines
Author M. Matillano

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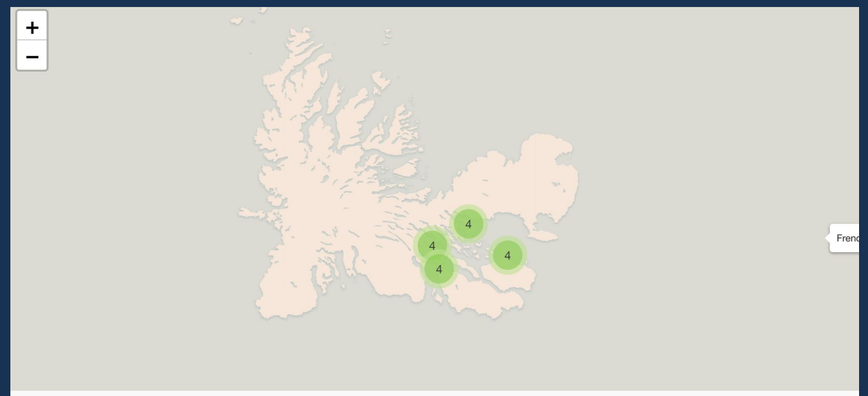
eDNA expeditions overview: globally rare species

✓ Endemic subspecies in Kerguelen – French Austral Lands and Seas



French Austral Lands and Seas

The French Austral Lands and Seas comprise the largest of the rare emerged landmasses in the southern Indian Ocean: the Crozet Archipelago, the Kerguelen Islands, Saint-Paul and Amsterdam Islands as well as 60 small sub-Antarctic islands. This 'oasis' in the middle of the Southern Ocean covers an area of more than 166 million ha and supports one of the highest concentrations of birds and marine mammals in the world. In particular, it has the largest population of King Penguins and Yellow-nosed albatrosses in the world. The remoteness of these islands from centres of human activity makes them extremely well-preserved showcases of biological evolution and a unique terrain for scientific research.

Samples	Localities	Target gene	Reads	RDP confiden...	VSEARCH ide...	NCBI ID	DNA sequence
EE0147	Ile Haute - Kerguelen	12S	49	0.8	100	OL505399	GTTGGTAAATCTCGTGCCAGCCACCGCGGTCATACGATTGACCCGAATTAATAGACACCCGGCGTAAAGAGTGTCAAG

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eDNA expeditions phase II: operational sampling

- ✓ The next phase of eDNA expeditions will start in January 2026!
- ✓ Focus:
  - ✓ Build operational sampling: conduct repeated small-scale sampling campaigns at sites
  - ✓ Start detecting trends
  - ✓ Evaluate how eDNA can help with this
- ✓ Please let us know, if you are connected with a marine site that could be interested to join!

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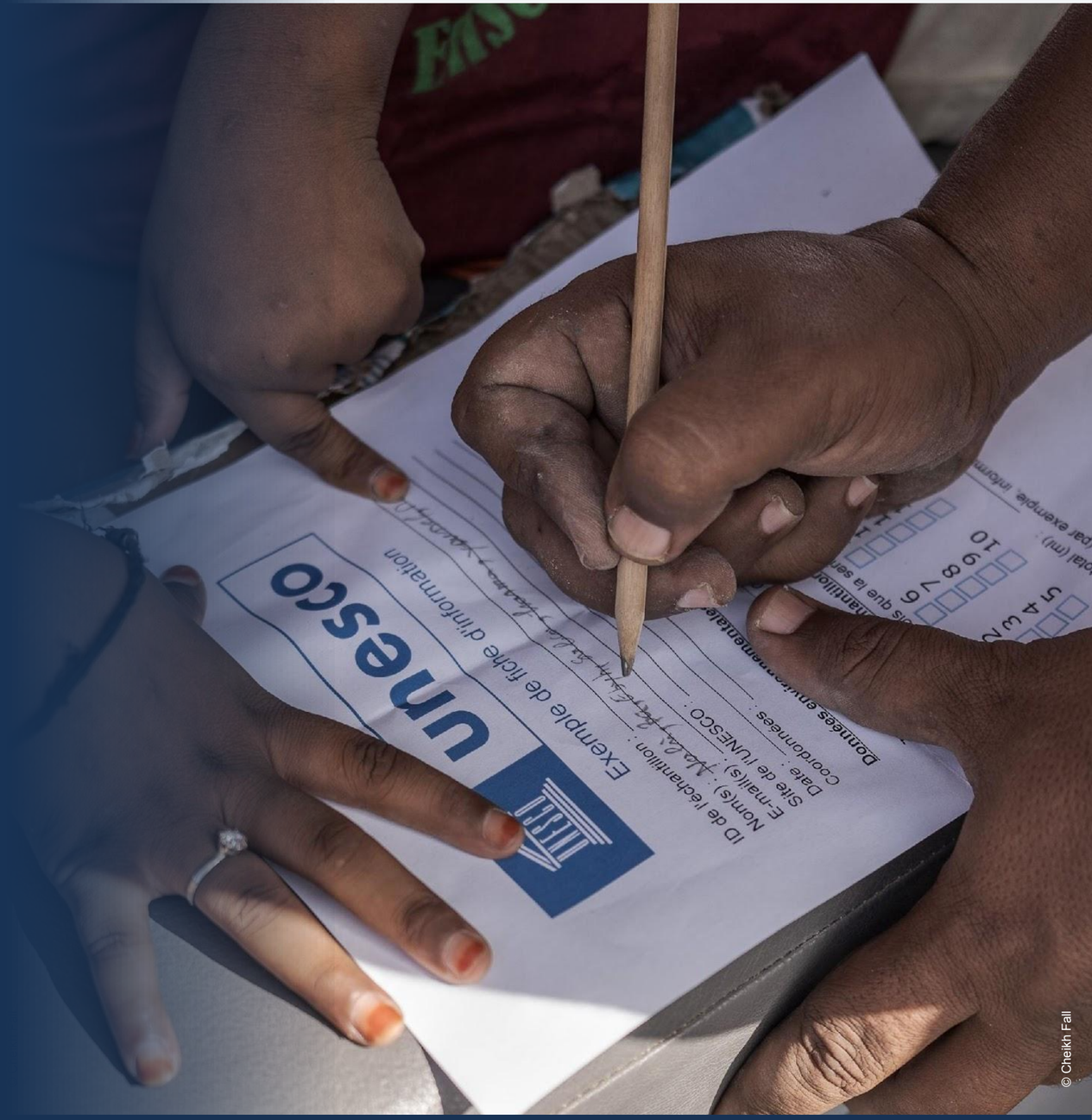
Conclusions

- ✓ Potential of eDNA
  - ✓ Helps fill data gaps
  - ✓ Increase knowledge on marine biodiversity
  - ✓ Help with monitoring MPAs and climate change effects
  - ✓ Help countries reach targets set by CBD and other international frameworks

- ✓ OBIS shares eDNA data in a FAIR and sustainable manner for the long-term



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Flanders
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