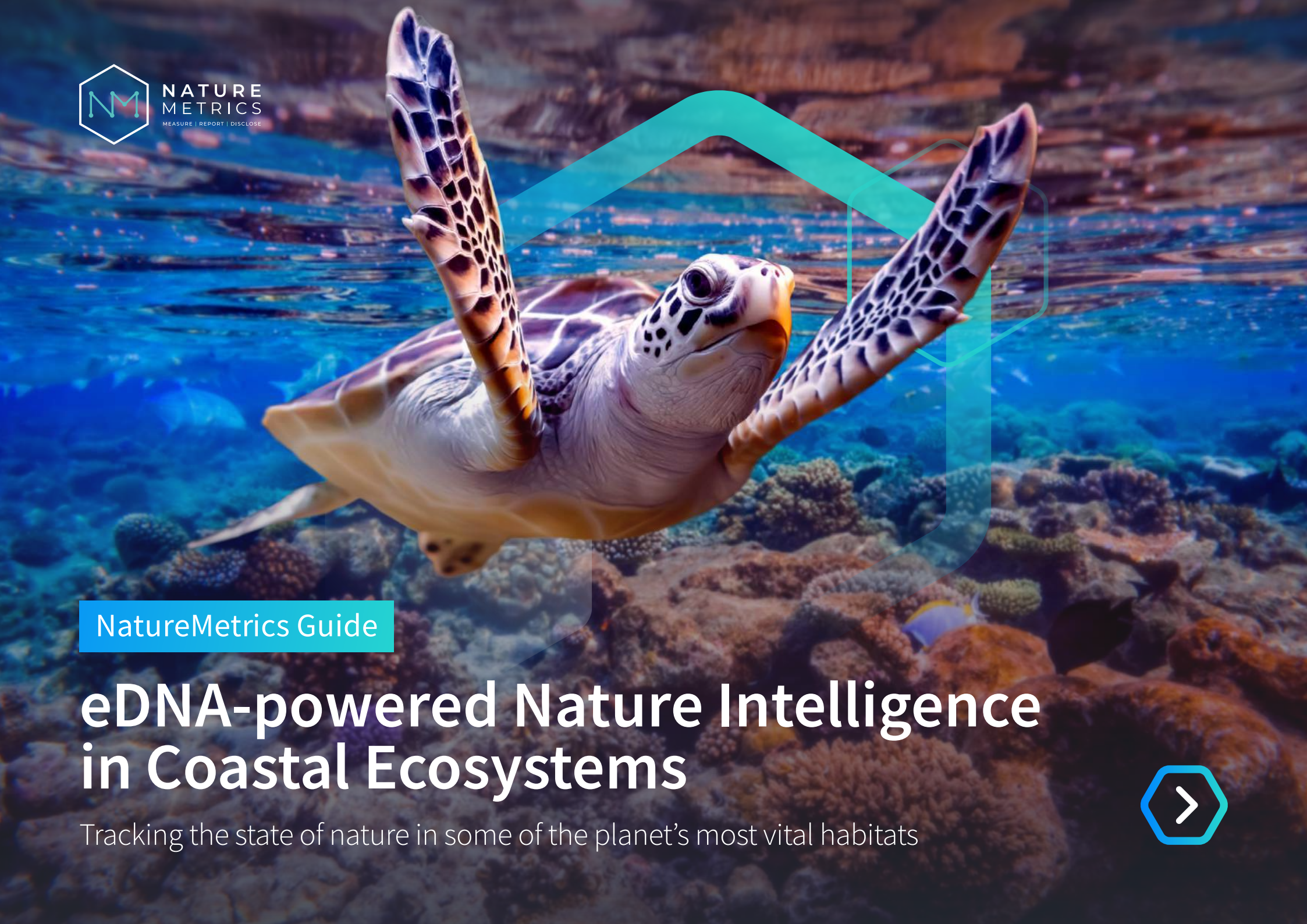

NATURE METRICS
MEASURE | REPORT | DISCLOSE

NatureMetrics Guide

eDNA-powered Nature Intelligence in Coastal Ecosystems

Tracking the state of nature in some of the planet's most vital habitats

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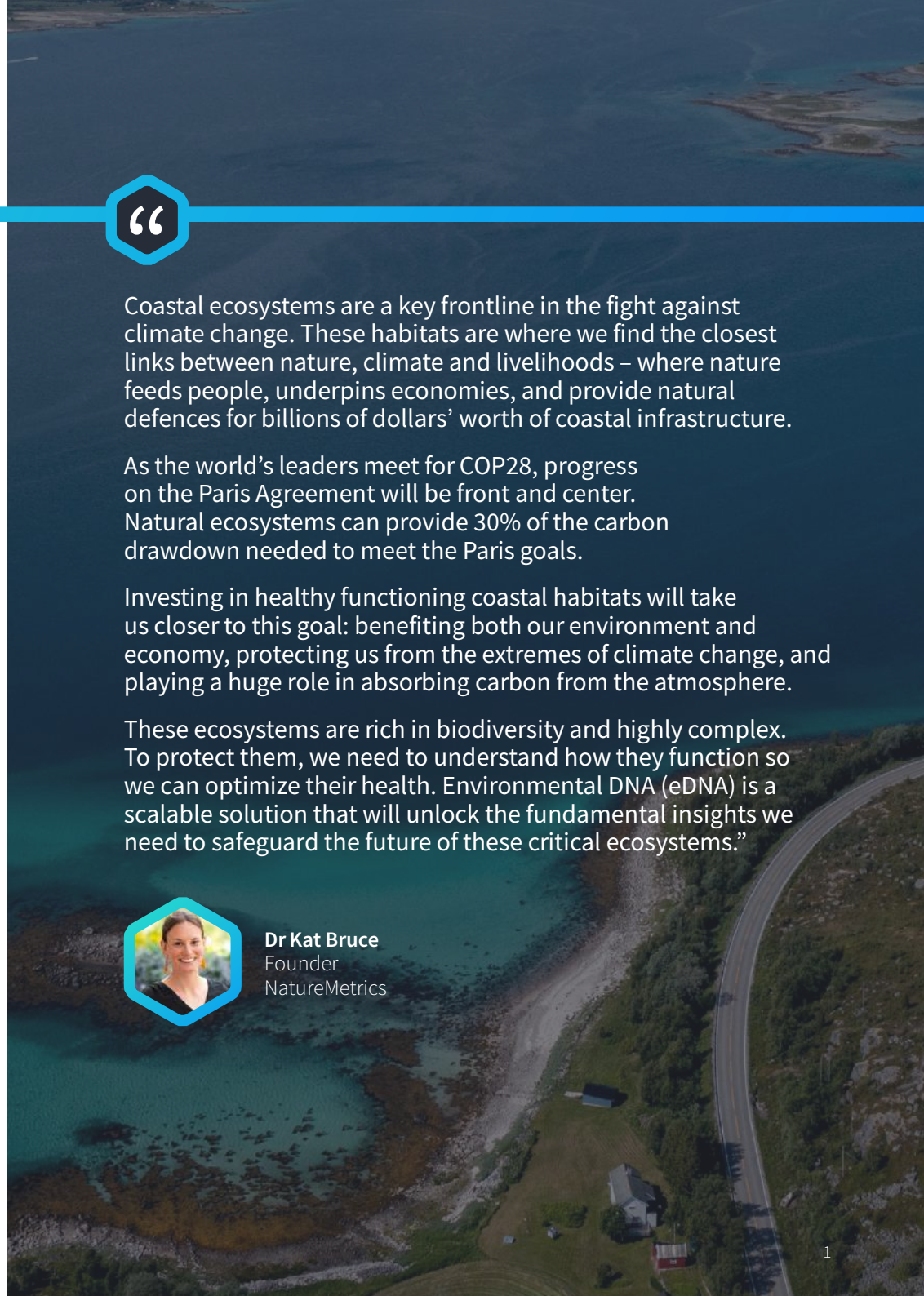


"Coastal ecosystems are a key frontline in the fight against climate change. These habitats are where we find the closest links between nature, climate and livelihoods – where nature feeds people, underpins economies, and provide natural defences for billions of dollars' worth of coastal infrastructure.

As the world's leaders meet for COP28, progress on the Paris Agreement will be front and center. Natural ecosystems can provide 30% of the carbon drawdown needed to meet the Paris goals.

Investing in healthy functioning coastal habitats will take us closer to this goal: benefiting both our environment and economy, protecting us from the extremes of climate change, and playing a huge role in absorbing carbon from the atmosphere.

These ecosystems are rich in biodiversity and highly complex. To protect them, we need to understand how they function so we can optimize their health. Environmental DNA (eDNA) is a scalable solution that will unlock the fundamental insights we need to safeguard the future of these critical ecosystems."

Dr Kat Bruce
Founder
NatureMetrics

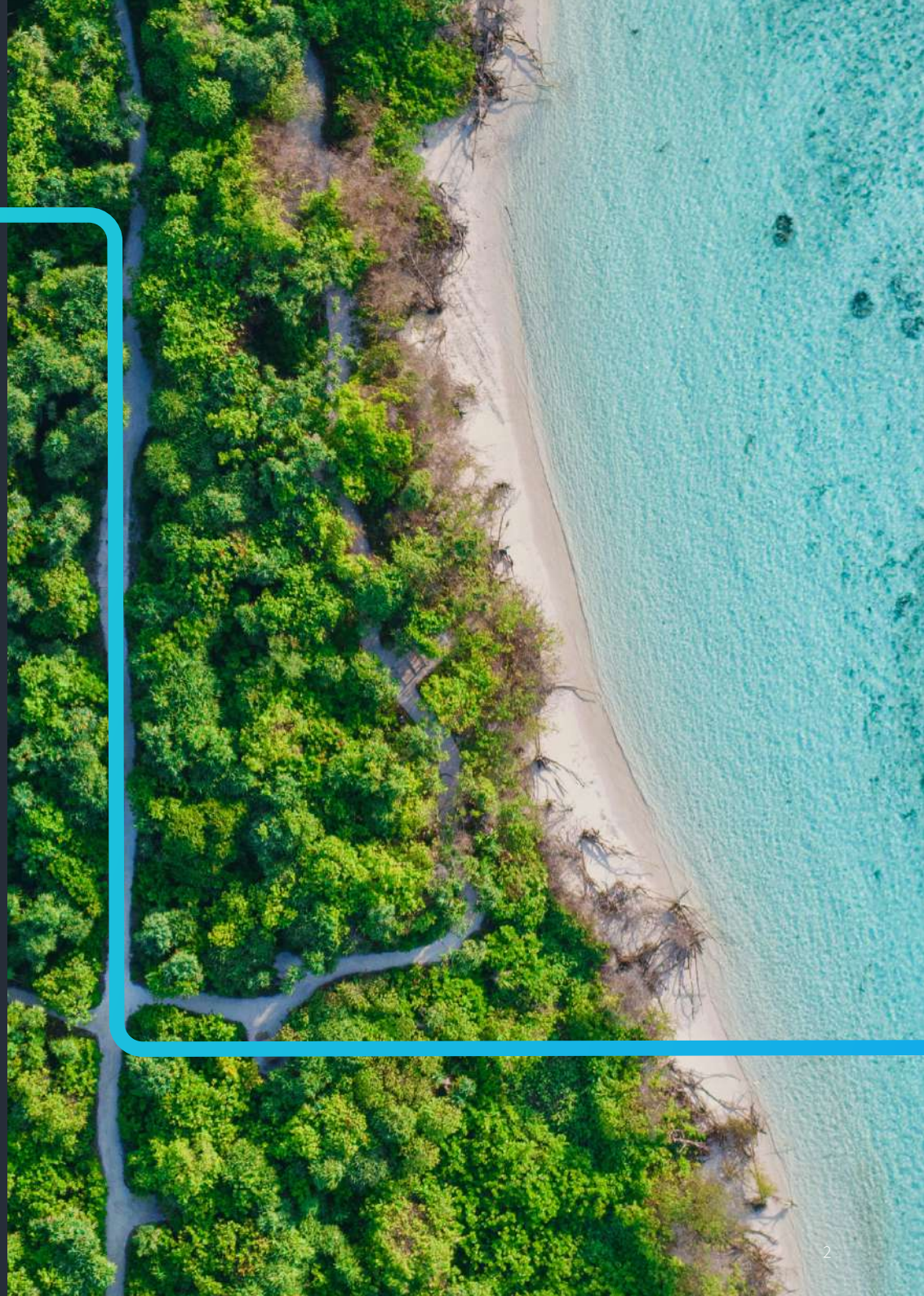
Introduction

Coastal ecosystems form the link between land and sea – a place where terrestrial and marine realms converge to sustain life in all its diversity. They include a wide range of habitats - from coral reefs, mangroves and seagrass beds, to kelp forests, salt marshes, oyster and chalk reefs, all of which provide critical ecosystem services, and all of which face a multitude of threats.

In addition to climate change, coastal ecosystems are threatened by unchecked development, pollution and overfishing. 2% of seagrass and 7% of mangroves are lost globally annually – with over a third having vanished in the last 50 years.

Losing these ecosystems would further erode our planet's natural defenses. By 2050, the world will have to foot an annual $1 trillion bill to protect and repair coastal urban areas[1].

These habitats are where the closest links exist between nature, people & climate.



Nature, People & Climate

Nature for People

- Coastal habitats connect over half a billion people to food security and jobs.
- Habitats provide shelter and nursery grounds for fish and invertebrates that support fisheries.
- 1.4 million people each year have lost protection from tropical storms due to ecosystem degradation in the last 30 years. At the same time, climate change is increasing the frequency and ferocity of storms, putting an additional 27 million people at risk. Coastal protection & restoration is the most cost-effective way to protect lives and livelihoods.
- The Blue Economy supports around 31 million jobs worldwide. This includes nature-associated jobs in sectors such as tourism, fisheries & aquaculture.
- Rising water temperature, deoxidization and acidification caused by climate change are expected to lead to a significant impact on fisheries and the availability and trade of fish products [2].

Nature for Climate

Coastal ecosystems provide some of the most powerful natural climate solutions, including services linked to both mitigation and adaptation. As a result, major global initiatives and programmes are aiming to channel billions of dollars of finance into restoration and conservation of mangrove, coral and seagrass ecosystems worldwide.

Mitigation

- Coastal habitats sequester carbon in their biomass and soils. Protecting and restoring them is a highly effective climate strategy for removing CO2.
- Carbon is locked away in the form of biomass (i.e. organisms themselves) as well as in the soils of habitats such as salt marsh, mangroves and coral.
- Per unit area, coastal vegetation sequesters more carbon than terrestrial forests.
- Seagrass ecosystems alone have been estimated to provide US$2.3trn in carbon-capture services.

Adaptation

- Mangroves and seagrass provide over $80 billion in annual flood protection services by absorbing wave energy and stabilizing shorelines.
- Coral reefs can reduce wave energy by up to 97%, sheltering over 200 million people from storm surges and flooding.

The resilience of these natural habitats – which dictates the extent to which we can rely on their continued delivery of their ecosystem services in the medium and long term – depends on the health of the overall ecosystem, including all components of biodiversity.

Invasive species, a lack of top predators to control marine herbivores, algal blooms or the loss of keystone species can put these systems into imbalance, leading to their collapse and the loss of their ecosystem services.

“For a long time the prevailing narrative has held biodiversity as a co-benefit derived from investment in climate projects. A nice-to-have. We need to urgently flip that narrative and recognize that it’s the biodiversity itself that drives the success of any outcomes linked to climate change. We invest in biodiversity and derive co-benefits linked to climate and the economy.”

Dr Kat Bruce
Founder
NatureMetrics

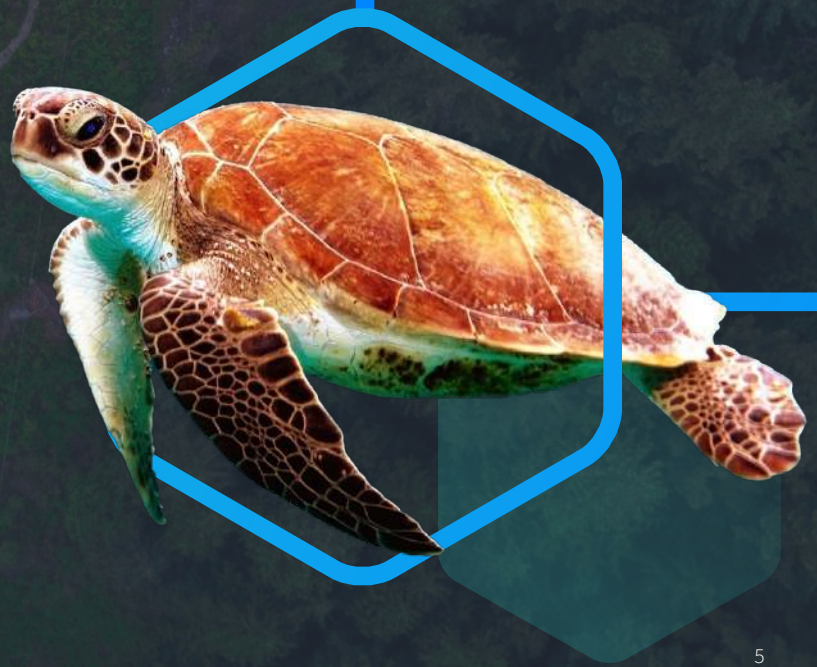
Why monitor biodiversity?

Investment into ecosystems requires standardized data and robust ecological performance metrics in order to:

- Quantify impact (positive or negative)
- Monitor the condition of the ecosystem
- Adaptively manage the ecosystem to optimize outcomes for people, nature & climate
- Quantitatively track progress towards science-based goals or targets
- Underpin issuance of high-integrity credits
- Enable rapid response to threats or loss of condition

Species detection and identification have traditionally relied on field surveys conducted by divers. These are labour intensive, subject to identification errors, limited in taxonomic scope and resolution, and hard to scale.

In recent years, new tools and technology have made collecting large amounts of data vastly more efficient and practical. In particular, environmental DNA (eDNA), underwater video and hydroacoustic monitoring are proving to be game-changers.

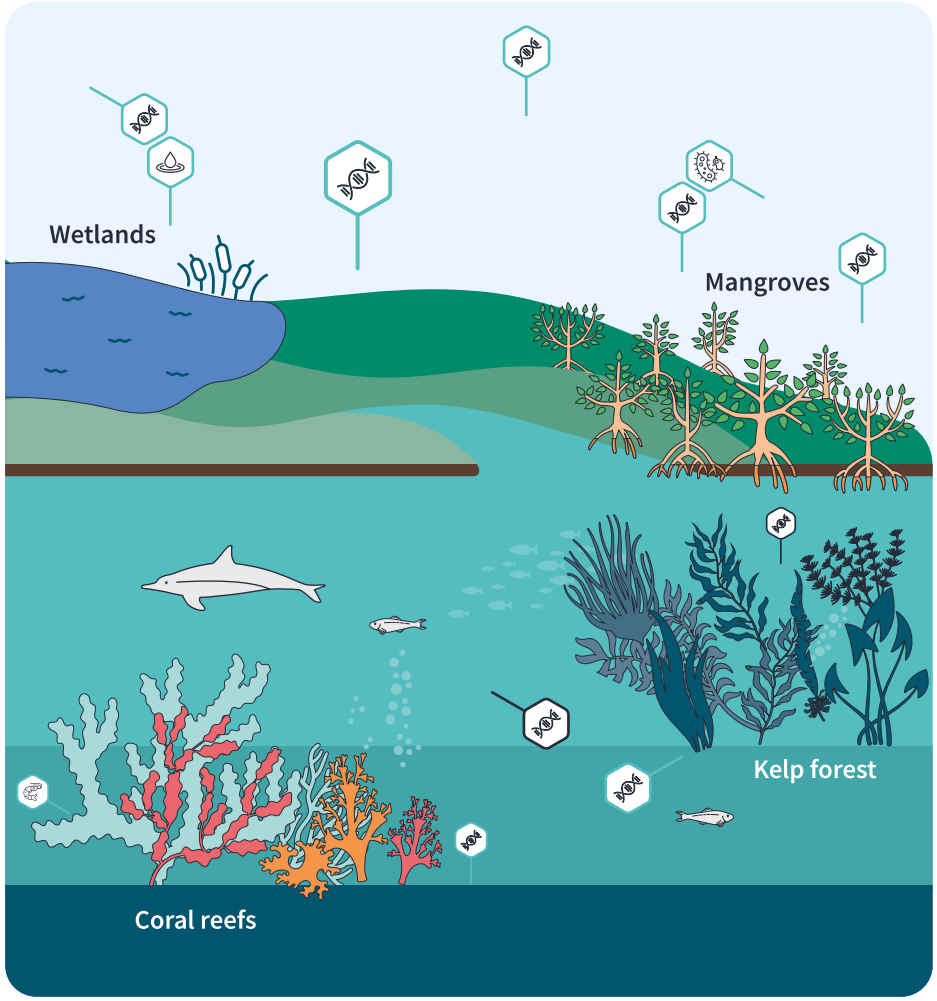


eDNA – transforming how we measure nature at scale

All living things shed traces of their DNA, which accumulate in the environment – including in water and soil, on surfaces & in the air. Capturing and analysing these traces allows us to generate datasets spanning the whole tree of life, from bacteria to blue whales.

- Samples are easily collected by non-specialists and sent to the lab for analysis
- Samples are processed in specialist, high-throughput lab facilities to generate data on chosen taxonomic groups
- Data is transformed into a range of metrics & indicators, enabling visualisation of biodiversity trends across time and space.

Applications of environmental DNA (eDNA) in Coastal environments



- Monitor pollution response
- Detect and predict harmful algal blooms
- Detect environmental change
- Detect rare and cryptic species
- Track restoration success
- Monitor climate change impact
- Environmental impact assessments
- Fisheries management
- Detect invasive species
- Rapid habitat health monitoring
- Identify impacts of industry
- Access difficult environments
- Community engagement and education

eDNA Methodology

Sample Collection and Lab Analysis

Survey design service

Our team can develop bespoke sampling plans tailored to your specific project needs. Drawing on our expertise in ecology, statistics and the behaviour of DNA in the environment, we can advise on where, when, and how to sample to ensure the data will provide the information you need.

Collect the DNA

Our kits make it quick and simple to collect high quality DNA samples from a variety of sources.

Water
From microbes to whales, aquatic eDNA is incredibly powerful in coastal systems

Sediments
Microbial and invertebrate diversity in intertidal or benthic sediments

Invertebrates
Send surface scrapes or invertebrate samples to identify their species composition

Send samples to NatureMetrics labs for analysis of chosen taxonomic groups

- Vertebrates
- Fish
- Mammals
- Freshwater insects
- Invertebrates
- Freshwater bivalves
- Eukaryotes
- Bacteria
- Fungi

Biodiversity data and metrics

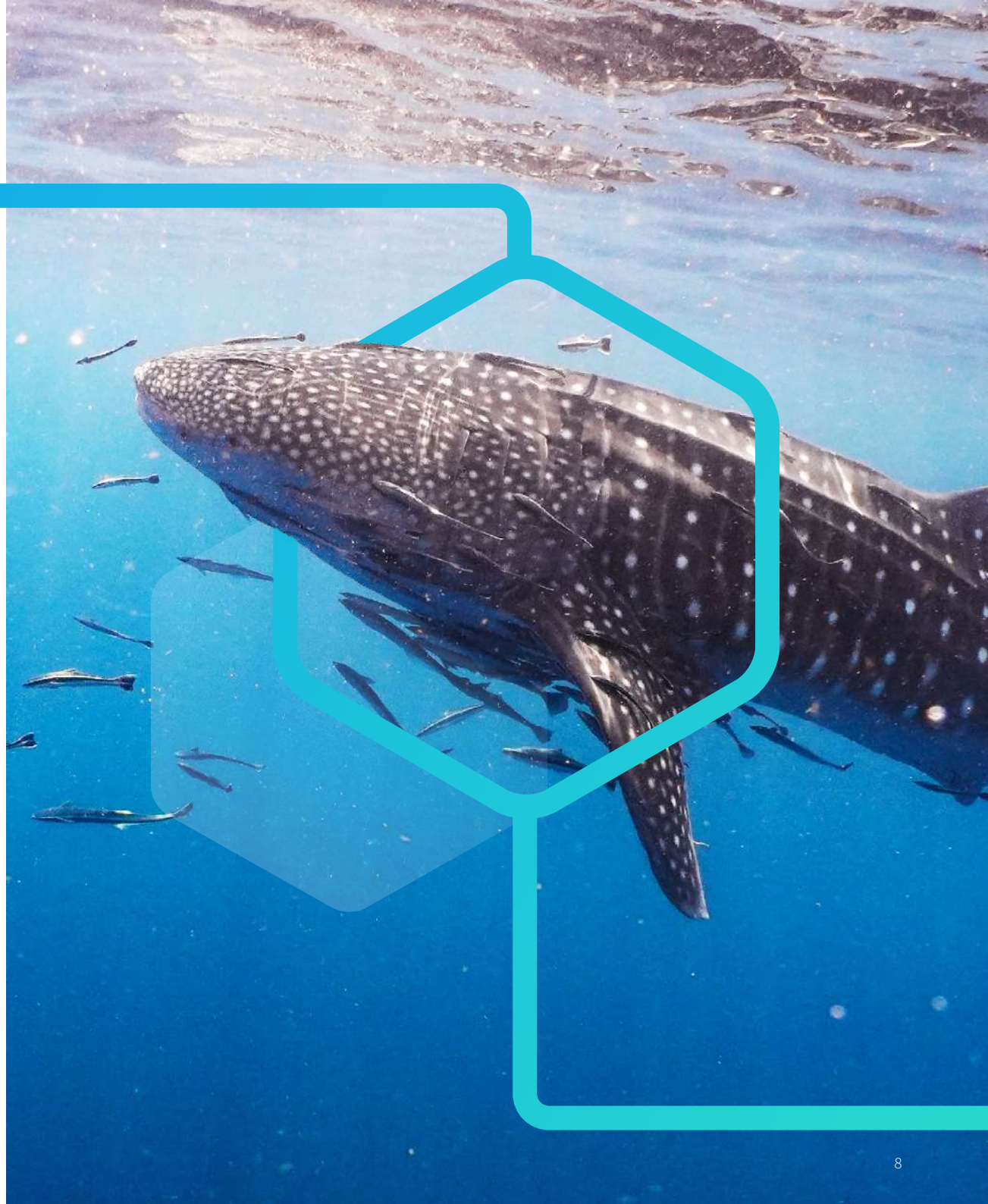
Datasets can be very large, containing hundreds or thousands of species. These are summarised into metrics and indicators that can be explored via our Nature Intelligence Platform.

- View data on a map
- Distributions of key species
- Compare diversity, health & function metrics
- View change over time
- Identify the presence of endangered or invasive species

“

It has been difficult in the past to get a good understanding of marine ecosystems. It is a highly dynamic, three-dimensional, complex, contiguous environment perfectly suited, however, to the incredible capacity eDNA has to characterize the species composition, ecosystem structure and function and a whole range of powerful metrics that allow us to understand … see… the sea in new ways. Our eDNA technology is able to unravel the mysteries of our oceans… how exciting is that!’’

Pippa Howard
Chief Nature Strategist
NatureMetrics



Understanding ecosystems with eDNA

eDNA is unrivalled in species composition monitoring. Analysis of a single set of water samples can yield data on thousands of species and enables multiple priorities to be addressed together, including:

- Establishment of comprehensive biodiversity baselines against which to measure future change
- Detection of rare species that may be of conservation or economic significance (e.g. endangered, invasive or commercially important species)
- Analysis of how species composition and diversity vary across different parts of a seascape
- Assessment of the distribution and habitat association of each species
- Selection of priority areas for restoration or protection

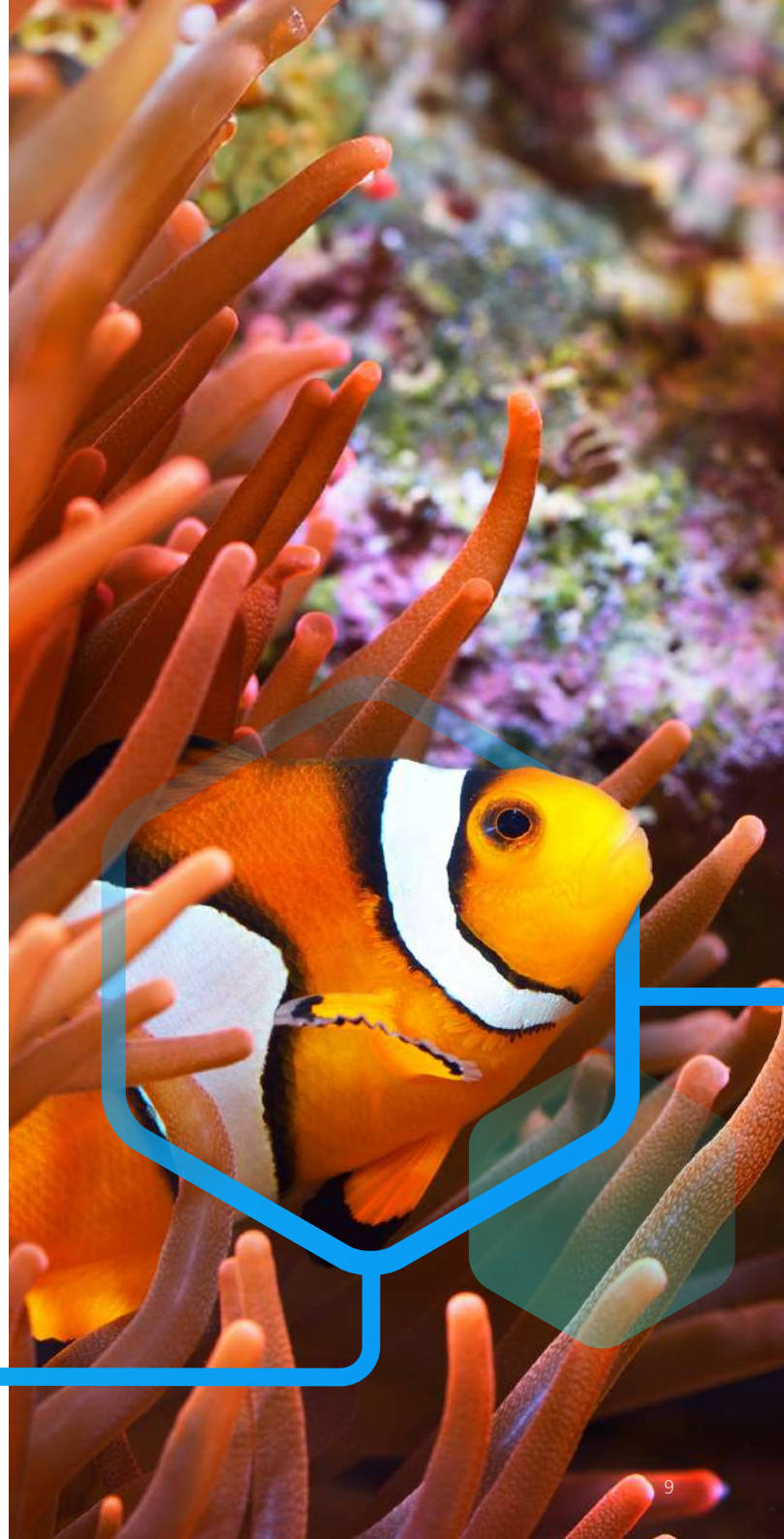
Long-term monitoring using eDNA enables seasonal patterns of biodiversity to be uncovered, negative impacts to be quantified and addressed, and progress towards ecological restoration goals to be tracked.

Spatial resolution

Despite the perpetual movement of water with tides and currents, marine eDNA signals are surprisingly localized. This is because eDNA dissipates fast in the vast volume of water, becoming undetectable before it has had a chance to travel far from where it was released by the organisms. This means that fine-scale differences can be observed even in adjacent habitats and relatively small areas. We have observed this in many of our projects, including those mentioned above, and it is also well documented in the scientific literature. Relevant studies include:

- Stat *et al.* 2018: https://conbio.onlinelibrary.wiley.com/doi/10.1111/cobi.13183
- Dugal *et al.* 2022: https://link.springer.com/article/10.1007/s00338-022-02301-3

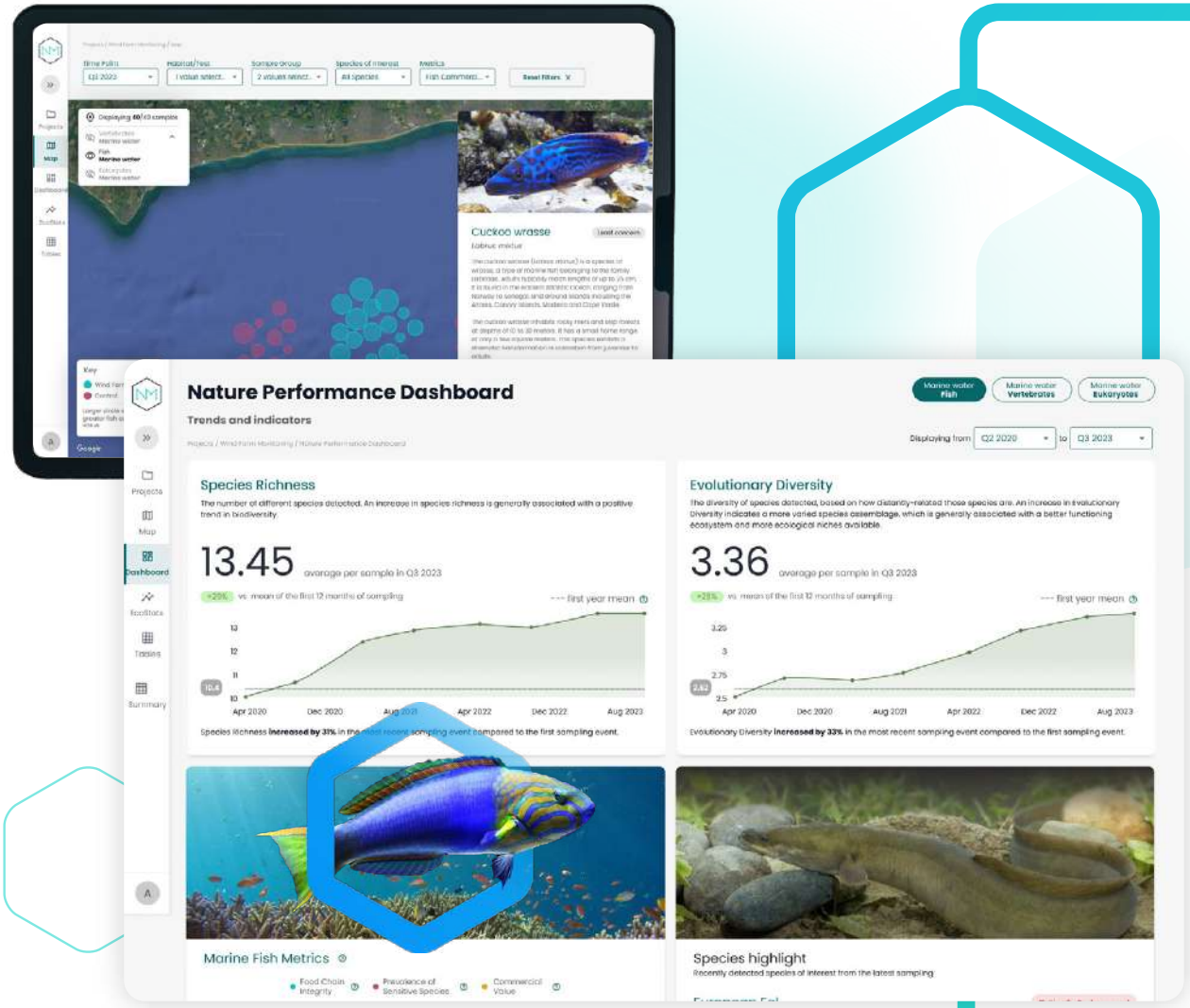
In deep water, features such as haloclines and thermoclines tend to cause vertical stratification of eDNA, but in relatively shallow coastal waters, eDNA samples taken from the sea surface are sufficient for detecting even bottom-dwelling species.

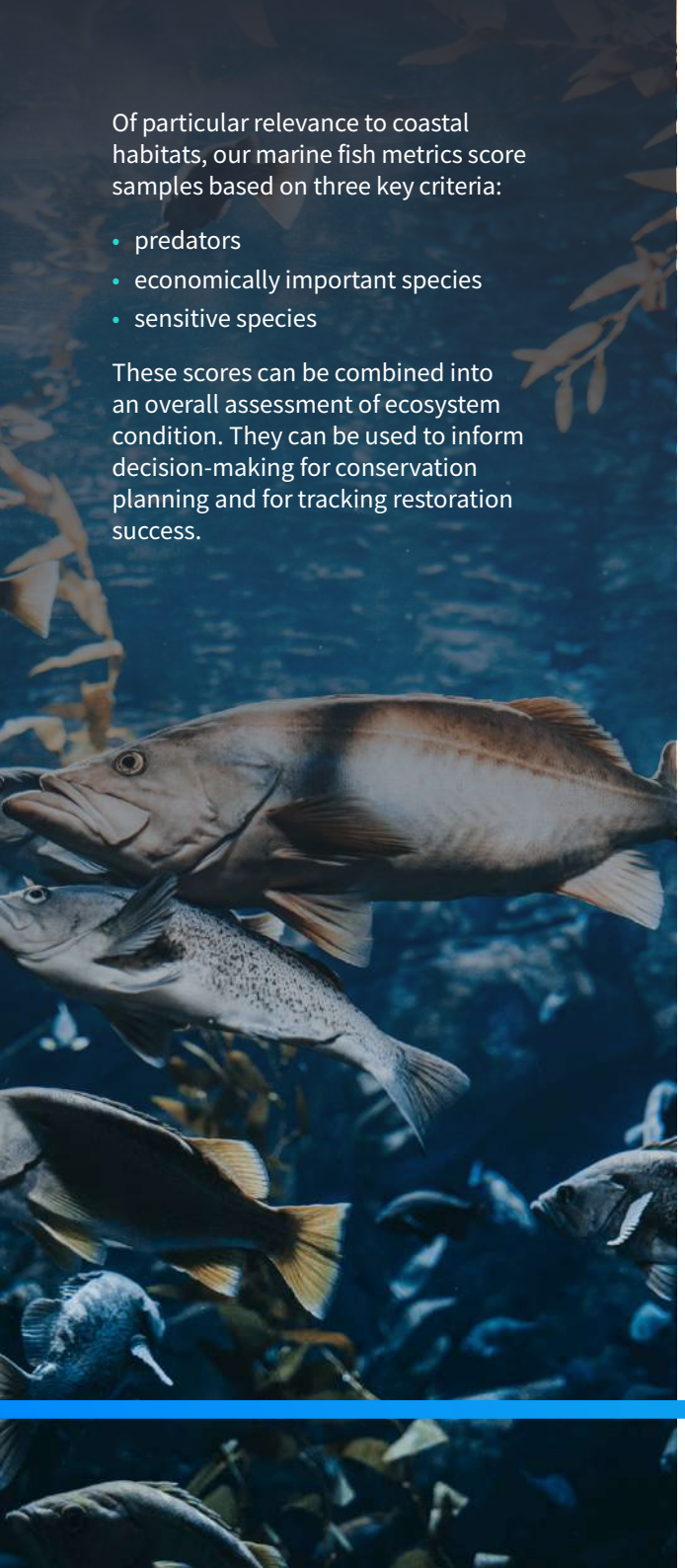


From data to insights

Ecological analysis of biodiversity data is complex and time consuming, especially when encompassing multiple taxonomic groups, time points, and habitat types. Launched in 2023, our NatureMetrics' Intelligence Platform makes it simple to read the stories the data has to tell:

- Quickly translate large volumes of eDNA data into actionable insights
- View species distributions and identify the presence of endangered and invasive species
- Track biodiversity and ecosystem health metrics across space and time
- Compare patterns among different taxonomic groups
- View data from a multiple sites in one place





Of particular relevance to coastal habitats, our marine fish metrics score samples based on three key criteria:

- predators
- economically important species
- sensitive species

These scores can be combined into an overall assessment of ecosystem condition. They can be used to inform decision-making for conservation planning and for tracking restoration success.

The marine fish community health package is comprised of three individual metrics

Fish Food-Chain Integrity

How intact the food-chain is.

Reveal whether protected areas are providing a safe space for complete food-chains to thrive. Track the return of predators following the reduction of pressures and impacts. Combine with all fish indices for full assessments.

Fish Commercial Value

How economically valuable your fish community is.

Reveal high priority areas for conservation efforts to protect species of high commercial value. Encourage growth of green economies by focussing monitoring on commercially valuable species. Combine with all fish indices for full assessments.

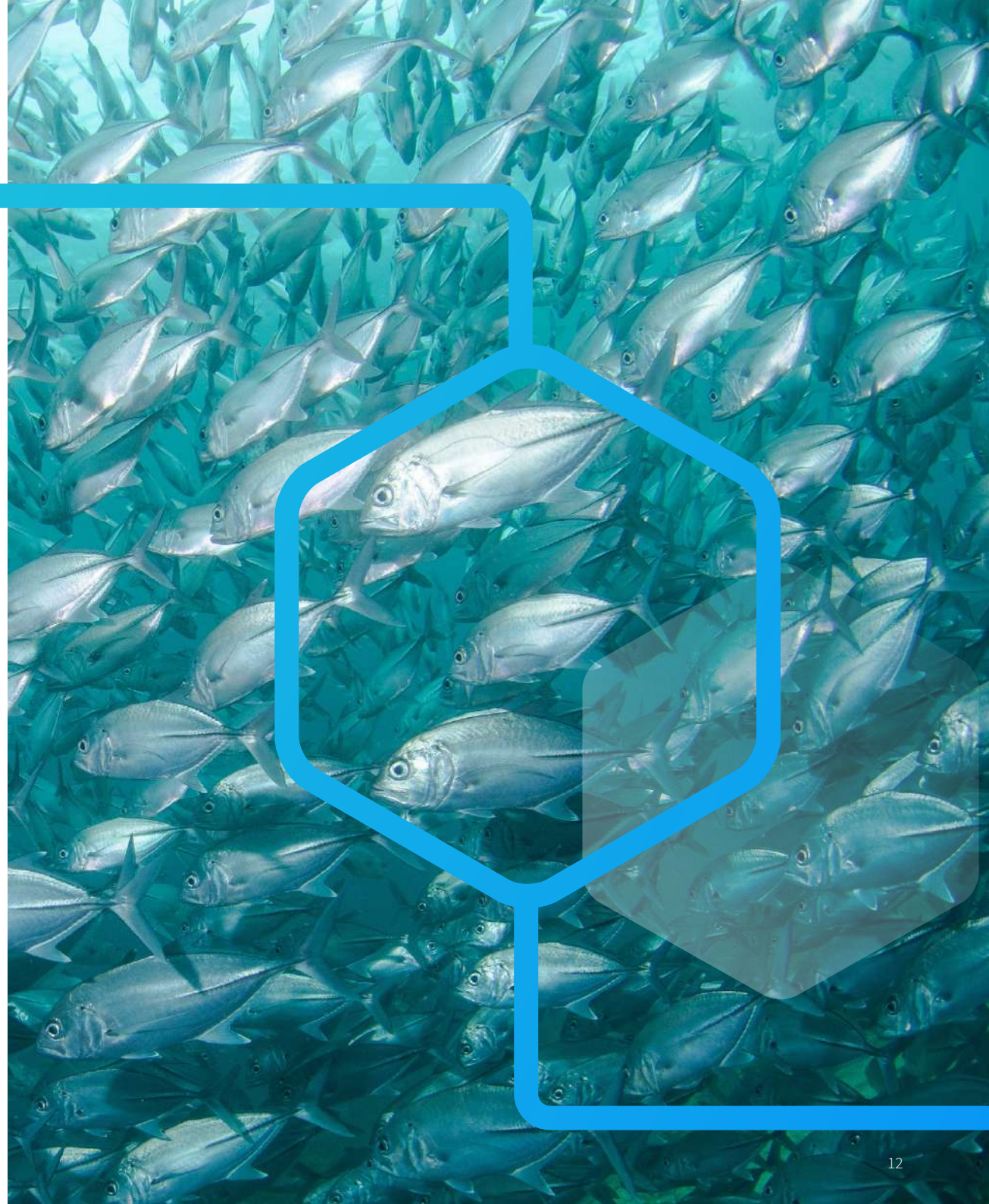
Prevalence Of Sensitive Species

The proportion of fish species considered vulnerable to human disturbance.

Track the return of vulnerable species after pressures have been reduced. Reveal high priority areas for conservation efforts to protect species that are highly vulnerable. Combine with all fish indices for full assessments.

“As we continue to witness the impacts of climate change, like storms and flooding, as species ranges shift due to warming seas, and we find an increase in invasive species, we are going to rely on resilient and interconnected coastal ecosystems more and more. By investing in our nature intelligence, businesses not only future-proof themselves on the journey towards NPI but also demonstrate their commitment to sustainability in a cost-effective manner. Together we can convert the complexities of nature into simple insights, leaving our legacy of healthy coastal ecosystems whilst meeting a nature positive blue economy.”

Nicole Yeomans
Account Executive - Marine
NatureMetrics



eDNA in Action

A participatory approach

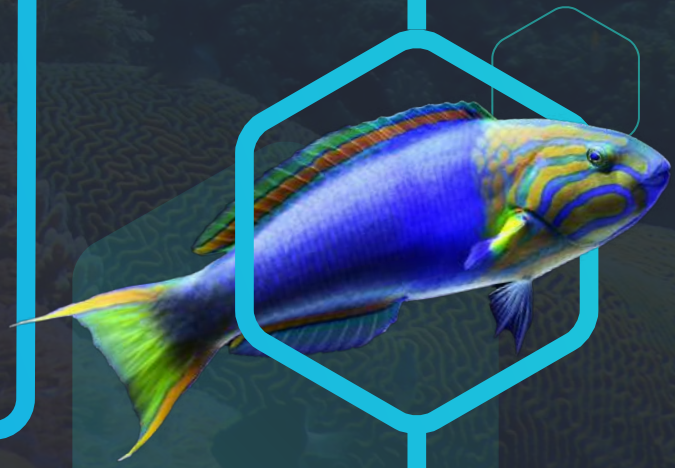
Local communities are the best guardians of natural resources, and their participation should be embedded in any monitoring program. eDNA fits well within community-led monitoring initiatives thanks to the robustness and ease of use of sampling kits. Simple training can be cascaded via a train-the-trainer approach, providing the opportunity to forge tight links between local knowledge and scientific data collection, at both the sampling and data interpretation stages.

Example

In Mozambique, we worked with local NGO Ocean Revolution Mozambique to train members of the local fishing council in Inhambane Bay how to collect eDNA samples. The training was carried out in the local language, Gitonga.

Samples collected by the local communities in the network of community-led MPAs revealed the presence of several whale and dolphin species as well as over 300 fish species, including **a huge variety of groups, from tropical reef fish to herrings and anchovies, mackerel, jacks, gobies, sand-eels, seahorses, flying fish, flatfish and many more. Results showed no significant difference to those from samples collected in parallel by researchers. This work has been peer reviewed and published in the scientific journal Molecular Ecology Resources.**

Link to paper



How does eDNA compare to other survey methods?

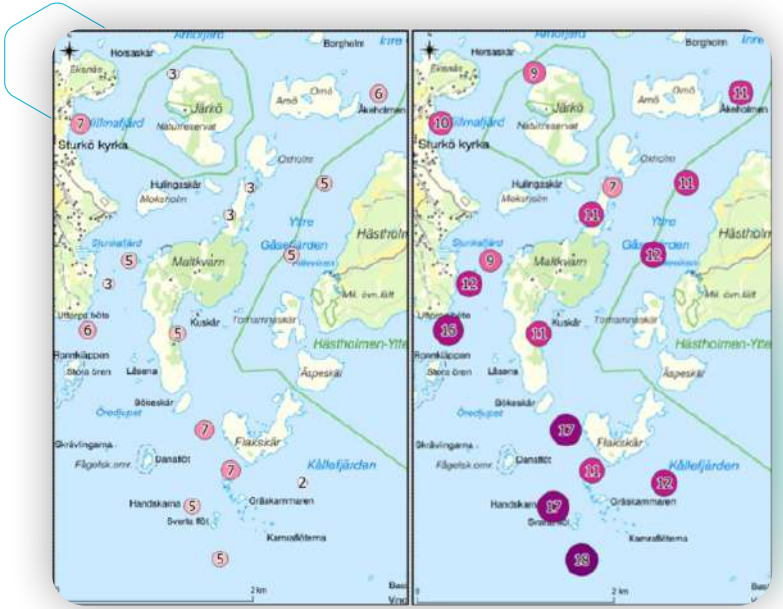
Most comparative studies in the marine environment have focused on fish, with eDNA usually outperforming other methods.

Net fishing in Sweden

On the West coast of Sweden, we worked with AquaBiota Water Research (now part of Niras) to compare eDNA with net fishing. At 16 locations, a single 3L eDNA sample was collected and nets were set overnight.

- eDNA detected more species than netting at every location
- eDNA detected a total of 24 species compared to 16 with netting
- eDNA detected an average of 12 species per location, compared to 6 with netting

Species detected only with eDNA included small species like sticklebacks, gobies and sand eels, which typically evade capture by nets but are of great importance from an ecosystem perspective.

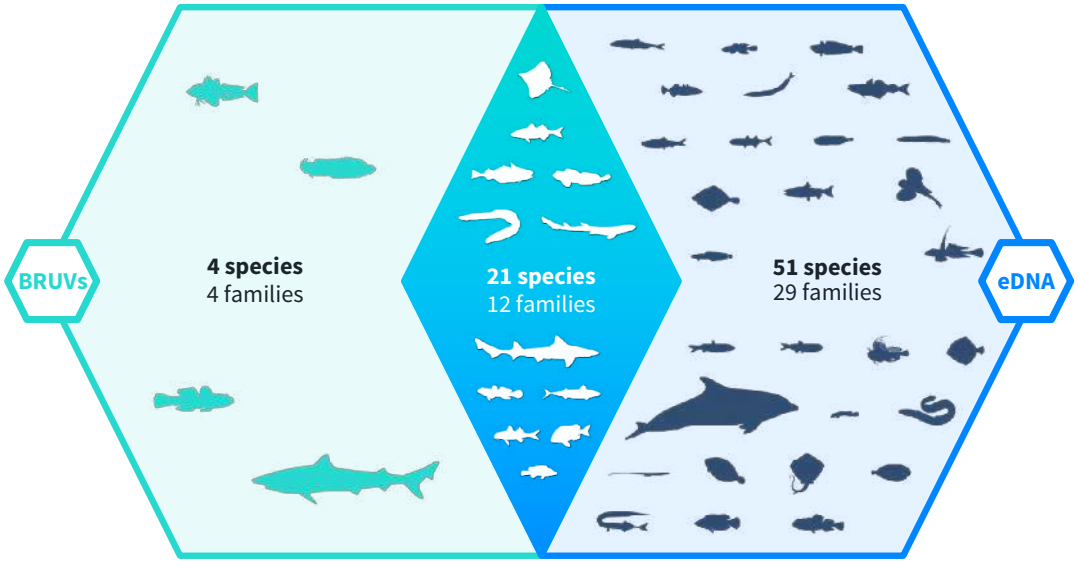


The map on the left shows the number of species identified using net fishing. The map on the right shows the number of species identified with eDNA at those same sites.

Baited underwater video surveys in the UK

In Sussex on the South coast of England, annual monitoring is taking place to track the recovery of the ecosystem following a trawling ban. University of Sussex is carrying out eDNA monitoring of fish alongside the use of baited remote underwater video surveys (BRUVs).

eDNA detected 3x the number of species as the BRUVs.

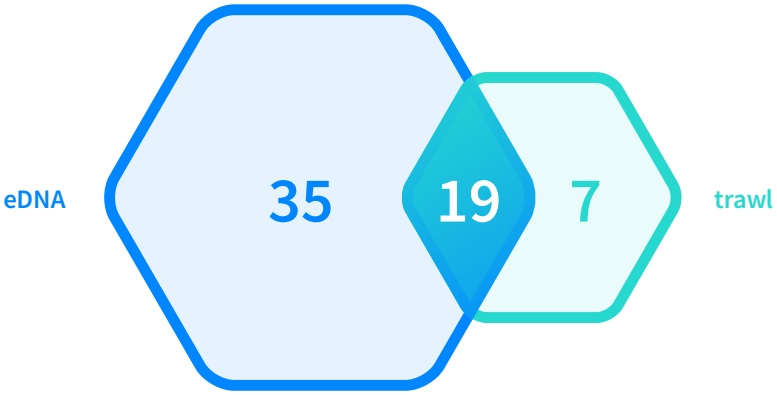


Trawling for wind farm monitoring

In partnership with EDF Renewables and Natural Power, we compared eDNA with trawling for fish surveys in and around wind farm sites in the North Sea.

eDNA consistently detected more species than trawling (54 species compared with 26), including smaller fish, migratory species and bottom-dwellers that are not easily captured in trawls. Four species of marine mammals were also detected from the eDNA. Analysis showed that the eDNA data provided a strong reflection of spatial and seasonal variation in fish communities as well as reliable diversity metrics enabling comparison of biodiversity inside and outside the turbine area. Trawling was not possible within the turbines so eDNA enabled this data to be captured for the first time.

Read the full report here: https://www.naturalpower.com/uk/insight/assessing-fish-ecology-around-owfs-using-edna



Many peer reviewed studies have been published that also report similar findings in habitats such as coral reefs and mangroves. Examples include:

- Gold *et al.* 2023: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260903
- Zainal Abidin *et al.* 2022: https://www.nature.com/articles/s41598-022-19954-3

“Coastal ecosystems such as mangroves, seagrass beds and coral reefs are keystones of the marine environment, providing essential habitats for thousands of species, protecting shorelines, and filtering water.

They are essential for the health of our oceans and our planet, providing nurseries for many commercially important fish and shellfish species, and playing an integral role in blue carbon sequestration. eDNA is a non-invasive monitoring tool that can establish the health of coastal ecosystems by assessing the communities present and provide the metrics needed to track the success of management and restoration initiatives. Put to good use, eDNA can drive an ecosystem-based approach to marine management and demonstrate the benefits healthy coastal ecosystems provide to the marine environment and the communities that depend on them.”

Clara Johnston
Marine Business Development Manager

Case studies: How eDNA works across different landscapes

Around the world, NatureMetrics is working with clients to shine a light on biodiversity in critical coastal ecosystems and help to inform effective conservation and restoration efforts. In almost every case - regardless of sector or habitat - the first step is to establish a robust biodiversity baseline against which future change can be measured.

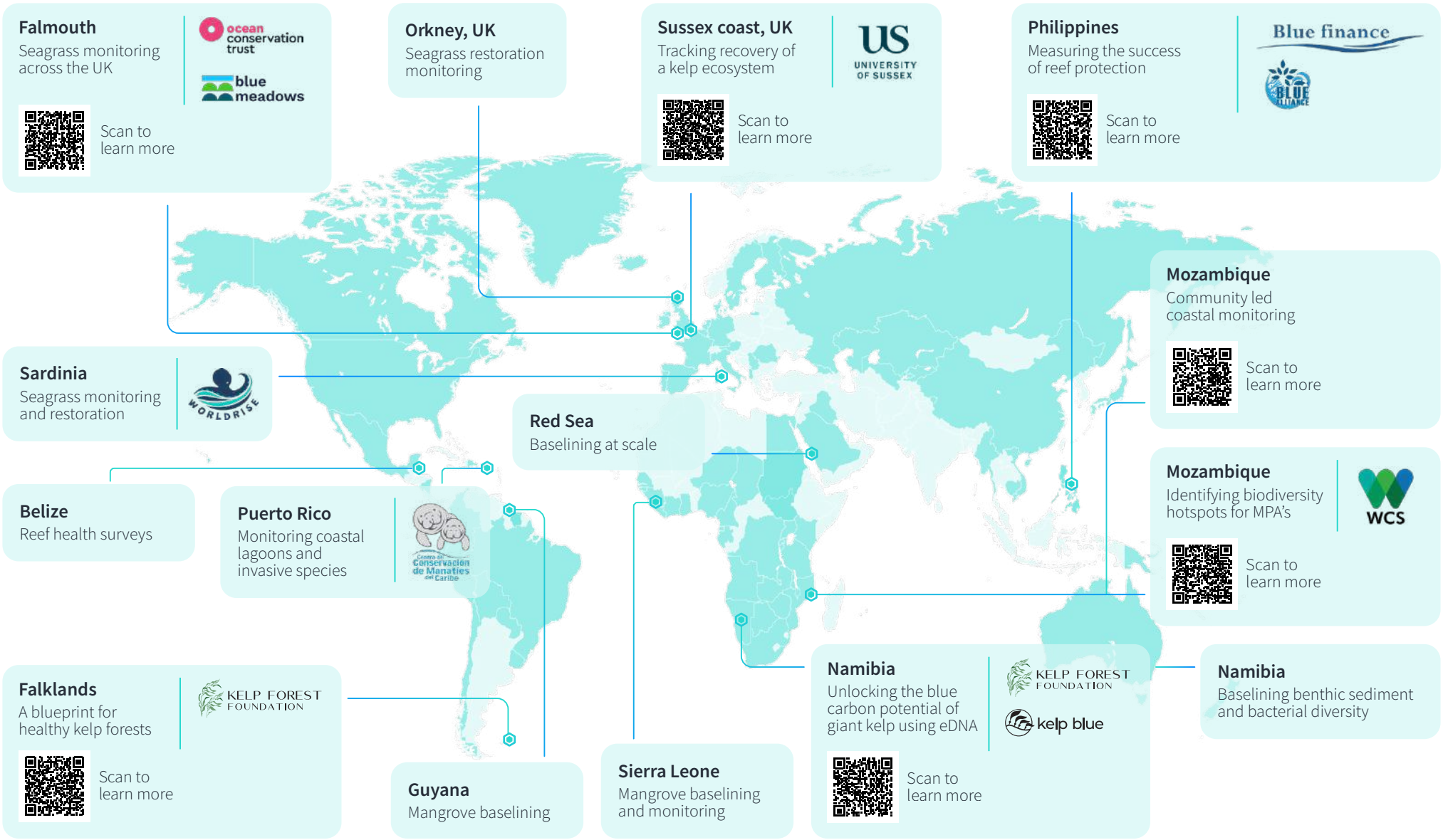
As new finance starts to flow into coastal ecosystems as natural solutions for climate and livelihoods, conservation projects will have more (and more diverse) stakeholders, and the expectations of quantitative reporting on progress and outcomes will only grow. Where outcomes are linked explicitly to financial flows (e.g. via credits for nature-based carbon or biodiversity) it is yet more critical to be able to evidence change since the project outset – or lack of change where protection is the goal.

At the same time, monitoring also enables adaptive management on the ground by providing regular information for conservation decision-making, optimizing outcomes through ongoing adjustment of strategy in response to data. When new threats arise (e.g. invasive species or pollution) routine monitoring will detect them early so they can be addressed promptly and cost-effectively.

eDNA is a perfect tool for establishing robust baselines and conducting ongoing monitoring in coastal habitats. Data across a huge range of taxonomic groups can be (1) obtained from a rapid, simple and cost-effective field effort that facilitates the participation of local stakeholders, (2) used to inform actions on the ground, and (3) reported in the form of summarized metrics to funders and other interested parties.

Global Coastal Ecosystem Projects

Around the world, NatureMetrics is working with clients to shine a light on critical coastal ecosystems and surrounding conservation efforts through eDNA monitoring.



Case study

Tracking recovery of a historic kelp ecosystem

Our multi-year eDNA surveys detected three times more marine species than conventional surveys and are being used to report on nature-positive impact, supporting the case for more conservation bylaws and Marine Protected Areas.

Context:

The Sussex Nearshore Trawling Bylaw was introduced in March 2021, banning trawling along the Sussex coastline in the hope that the kelp forest ecosystem that used to thrive in these waters would recover. The Sussex Kelp Restoration Project is a significant multistakeholder initiative. Evidence of ecosystem recovery following the ban will be crucial for securing its extension beyond the initial 5-year term.

More information

Our role:

Working in partnership with University of Sussex, we have compiled a detailed biodiversity baseline in year 1 and are conducting annual monitoring thereafter. eDNA samples are collected by researchers alongside deployment of baited remote underwater cameras (BRUVs) to maximise data capture and enable comparison of methods. Samples are also collected in mature kelp forests that persist further along the coastline, providing a picture of the biodiversity that might be expected in the survey area post-restoration. Samples were analysed for fish and other vertebrates plus a broader cross-section of eukaryotic diversity spanning everything from invertebrate animals to seaweed and microalgae.

Video Surveys

7 hours per site

8 hours per species

eDNA Surveys

25 minutes per site

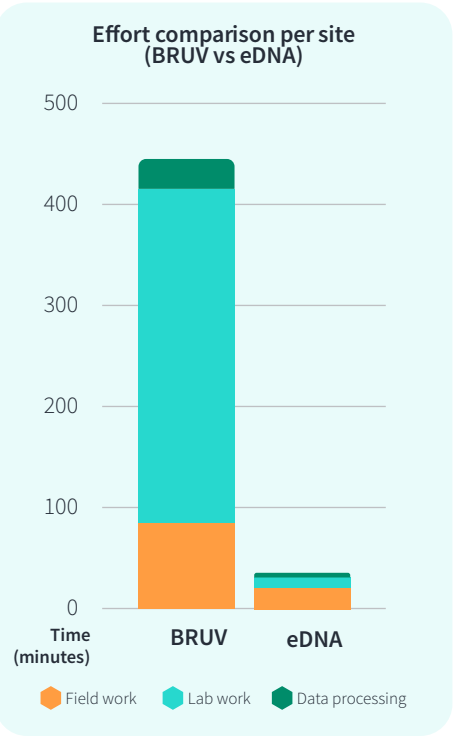
1.25 minutes per species

- In the 2021 baseline survey, eDNA detected over 70 vertebrate species, with species richness increasing from East to West across the survey area (remnants of habitat persist at the West end). This pattern is less clear in the 2022 dataset, which could be an early sign of recovery.
- An impressive diversity of elasmobranchs (sharks and rays) were recorded in this project, with 7 species recorded in 2021 and 9 in 2022, including the Critically Endangered Tope (Galeorhinus galeus).
- The Eukaryote dataset comprises 673 species including marine invertebrates (worms, clams, scallops, mussels, urchins, brittle stars, anemones, shrimp, sponges etc), brown, green and red algae, diatoms and other microscopic groups. This holds huge power for tracking the progression of the whole ecosystem as it recovers from trawling.

eDNA detected three times as many marine vertebrate species as the BRUVs, and detected several important species that were not captured by video. Video surveys, including fieldwork and data processing, required a total effort of 7 hours per survey site, equivalent to 8 hours for each species detected. In contrast, our eDNA analysis reduced the effort to just 25 minutes per survey site or 1.25 minutes per species detected. These time savings highlight the exceptional efficiency and cost-effectiveness offered by eDNA technology.

Relevance:

This project demonstrates the unparalleled power of eDNA as a tool to track biodiversity recovery at scales never previously possible. Robust data from time and cost-effective sampling is crucial for implementing effective conservation actions at scale and justifying future conservation bylaws and Marine Protected Areas (MPAs). The University of Sussex are continuing to monitor annual ecosystem recovery using eDNA.



“eDNA metabarcoding provides enhanced time saving and greater conservation capabilities than some other traditional survey methods (for example detecting the critically endangered European eel!), which provides greater alignment with restoration goals, such as the SDG14 and CBD 30% by 2030. We look forward to seeing the changes in the ecosystem in the coming years through the results of our eDNA sampling.”

Alice Clark
University of Sussex

Case study

A Spotlight on Mozambique's Coastal Biodiversity: eDNA Illuminates Conservation Priorities

WCS Mozambique conducted comprehensive eDNA sampling along the northern coast of Mozambique to establish biodiversity baselines for degraded coral reefs, mangroves, and seagrass beds. The insights are being used to inform the placement of community-managed fisheries areas and strengthen the strategic expansion of Mozambique's marine protected area (MPA) network.

More information

Our role:

In 2022, WCS collected eDNA samples from across coral, mangrove, and seagrass sites along the northern Mozambique coastline using the NatureMetrics service. NatureMetrics analyzed the samples, detecting species across taxonomic groups, and converted this complex data into simple actionable nature insights using NatureMetrics metric offerings and Nature Intelligence Platform.

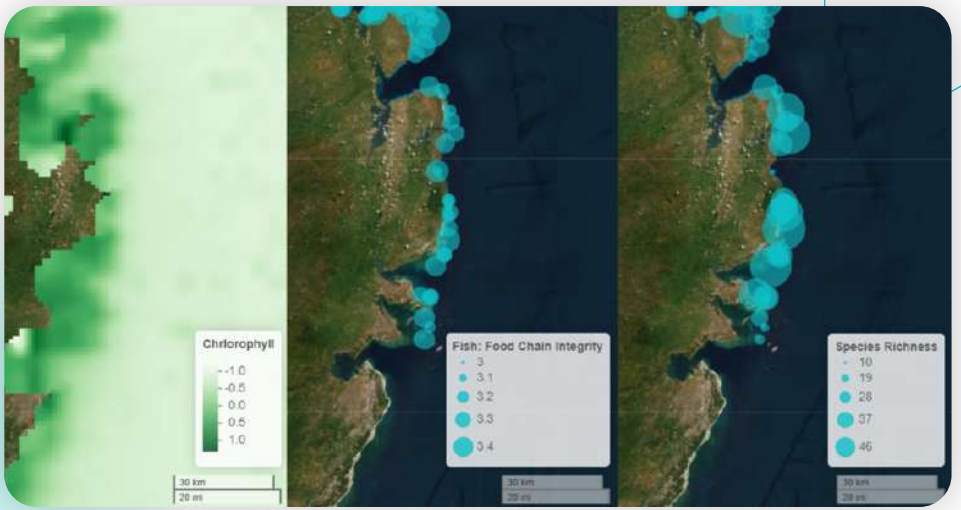
The eDNA insights were combined with Earth Observation (EO) data and other biodiversity datasets collected by WCS. This comprehensive approach will allow WCS to explore the potential for seascape-scale biodiversity maps in which the eDNA data is used to groundtruth the EO data so that species distributions can be predicted across much larger scales, thereby increasing the level of insight that can be gained from these tools for informing conservation planning and large-scale monitoring.

The challenge:

Stretching over 1500 miles, Mozambique's diverse coastal habitats support rich biodiversity and millions of livelihoods. However, overfishing and habitat degradation increasingly threaten these ecosystems. To expand Mozambique's MPAs, WCS needed a practical way to rapidly gather a robust biodiversity baseline across the whole coastline to identify conservation priority areas.

The impact:

The multifaceted baseline is guiding WCS's proposal for a new large-scale MPA incorporating a network of community-managed fisheries areas. Ongoing sampling will enable WCS to track biodiversity gains over time as protections take effect, ensuring conservation efforts translate into positive outcomes for nature and local communities, ultimately strengthening the marine conservation area network and Blue Economy in Mozambique.



Case study

A Blueprint for Healthy Kelp Forests: Robust eDNA Baselining in the Falklands

KELP FOREST FOUNDATION

eDNA sampling was conducted across the Falkland Islands' pristine giant kelp forests as part of a wider effort to establish biodiversity benchmarks for global kelp forest restoration efforts. eDNA generated ecosystem-scale insights in this remote region, illuminating hidden diversity and providing a blueprint for pristine kelp forest health to use in the development of universal kelp ecosystem health metrics.

More information

Context:

The Falkland Islands host some of the most pristine giant kelp forests in the world, but these are relatively understudied due to their remoteness. Kelp Forest Foundation is aiming to survey these unique habitats while they remain intact, establishing benchmarks for restoration worldwide.

The remote location of the kelp forests posed immense logistical barriers, making expert-led traditional monitoring methods infeasible within the required short timescale.

The Foundation required a practical solution to quickly conduct a survey that could generate biodiversity insights across the tree of life, without needing to mobilise a full suite of taxonomic experts to undertake fieldwork.

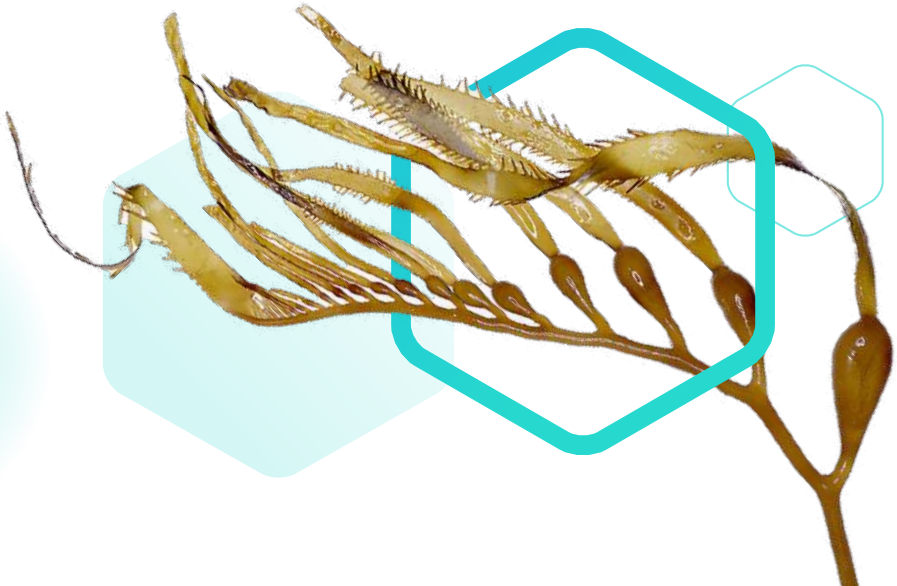
eDNA analysis:

NatureMetrics aquatic eDNA sampling kits were sent to the Falklands where local collaborators were trained in collection of samples. which were analyzed at our UK lab. No taxonomic expertise was required during in-field sampling.

Our DNA analysis revealed over 389 species across the whole tree of life, ranging from penguins and southern elephant seal to fish, sponges, shellfish, jellyfish, sea stars and many lesser-known tiny organisms that almost certainly play a multitude of functions in maintaining the overall ecosystem.

The impact:

eDNA sampling enables whole-ecosystem data to be obtained quickly and efficiently in remote locations with the participation of local stakeholders. The data generated in this project will be used to feed into modelling approaches combining data from other kelp forests around the world so we can learn how biological communities in giant kelp habitats respond to stressors like climate change. The data will anchor the modelling of simple, accurate metrics of ecosystem health that can be used to quantitatively measure the performance of conservation, restoration, or sustainable use of giant kelp forests, guiding ecosystem management worldwide.



“This groundbreaking study represents a significant milestone in our understanding of what are potentially some of the most pristine kelp forests in the world. The use of eDNA analysis allows us to gain a detailed picture of the biodiversity present in similar comparative ecosystems, which will be invaluable for future preservation efforts.”

Samantha Deane
Managing Director of
The Kelp Forest Foundation

Oly Dempster of Falkland Islands Film Company created a stunning video that showcases the project and the remarkable kelp forest environment in the Falkland Islands

Case study

Understanding biodiversity impacts of offshore Giant Kelp farming

We are working with Kelp Blue and the Kelp Forest Foundation to evaluate biodiversity impacts of an offshore giant kelp farming pilot project off the coast of Namibia. Our data is providing a detailed biodiversity baseline and assessment of changes over time as the pilot farm develops.

More information

Context:

Large-scale offshore kelp farming holds exciting promise for boosting biodiversity, creating sustainable jobs and products, and sequestering carbon. However, before scaling up, these potential benefits need to be demonstrated - and potential negative impacts need to be investigated too. For instance, it was unknown how wild and farmed kelp would interact, and critics were concerned about the threat of unintentionally introducing alien species.

Our role:

NatureMetrics provided training to the Kelp Blue team and eDNA kits were provided for monthly sampling by Kelp Blue staff and Namibian postgraduate students in and around the pilot site and control sites over two years as the farm developed.

Samples were analysed to provide data on taxonomic groups ranging from vertebrates to microorganisms, establishing a robust biodiversity baseline against which community changes can be monitored over time as the site develops.

The data:

Vertebrate data included 25 fish species, including threatened species such as the Sun Fish (Mola mola; listed as Vulnerable on the IUCN red list), and endemics such as the Cape Elephantfish, a species of Chimera. Endangered African penguins and cormorants were also detected, along with several cetaceans including Humpback Whale and Heaviside's Dolphin and the Cape Fur Seal.

Invertebrate data includes species as diverse as rock lobsters, urchins and sea stars, jellyfish and mussels.

Ecological analysis of the data is already starting to yield insights around seasonal and spatial patterns of biodiversity. This is being combined with many other types of data being collected, building up a multidimensional picture of how the ecosystem is changing as the cultivated kelp matures.

The robust baseline empowered Kelp Blue to responsibly scale cultivation and will support the development of a universal kelp ecosystem health metric to inform kelp ecosystem conservation globally. The quantified biodiversity gains can unlock pioneering biodiversity credit finance, catalyzing investment in seaweed ecosystems and sustainable blue economies globally.

Additionally, by upskilling local teams in eDNA sampling methodologies, the project strengthened national capacity for science-based monitoring into the future.

KELP FOREST FOUNDATION

kelp blue

"This work will go a long way in solving some of the biggest challenges seaweed cultivators are facing in the development of a verified Biodiversity Credit"

Caroline Slootweg
Co-founder & CCO

Case study

A Blueprint for Large-Scale Seagrass Restoration along the UK Coastline

eDNA surveys provided critical biodiversity insights to support the Ocean Conservation Trust and Blue Meadow's pioneering project to protect and restore 100 hectares of seagrass meadows in Falmouth Harbour and along the south coast of the UK. Our monitoring solution is providing the data needed to track restoration outcomes, efficiently report back restoration outcomes to stakeholders, and make the case for expanded conservation measures. Seagrass monitoring using eDNA is now being scaled across all Blue Meadow sites.

More information

Context:

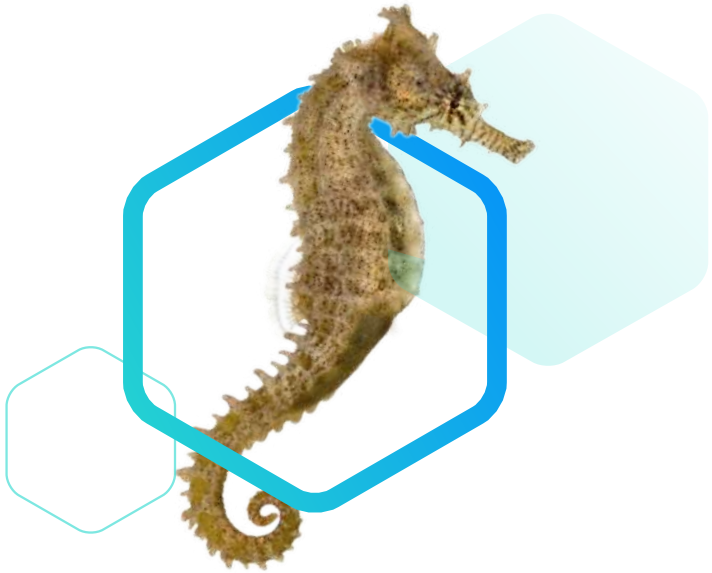
The Ocean Conservation Trust and Blue Meadows have a 5-year goal to protect and regenerate 700 hectares of seagrass meadows across the UK through conservation and restoration efforts. They needed a biodiversity monitoring method that was highly scalable to cover this extensive area, track the outcomes of their interventions, and a framework to easily report these outcomes back to stakeholders and the public. Conventional survey methods that had been previously trialed, including baited underwater videos (BRUVs), were too expensive and time-consuming to provide ecosystem-scale insights.

Our role:

To establish a robust biodiversity baseline across the Trust's restoration sites in Year 1, 18 sites were surveyed for fish with eDNA, revealing the presence of over 50 fish species.

These included several species of pipefish, gobies, blennies, wrasses, clingfish, rockling and sand eels as well as the more familiar commercially-fished species.

Sand-eels and sand smelt were the dominant species, accounting for over half of the total eDNA signal in almost every sample.



The impact:

eDNA monitoring equips the Ocean Conservation Trust and Blue Meadows to:

- Evaluate the ecological progression of sites following seagrass planting, tracking restoration success.
- Efficiently monitor large-scale regeneration projects that have received investment and report back to stakeholders.
- Detect threats like invasive species and pollution impacts early.
- Engage the local community in sampling events
- Communicate insights to the recreational users and community members whose livelihood is influenced by the habitat.

By enabling robust, comparable, monitoring of seagrass biodiversity across the UK as restoration activities progress, including key fisheries species, eDNA technology supports the Trust's mission to reverse decades of decline in these invaluable habitats at scale. There are now plans to scale eDNA monitoring across all Blue Meadow sites and complete comparable surveys in every season.

Case study

Measuring the Success of Reef Protection

Blue Finance used eDNA to assess coral reef biodiversity on and around the Puerto Galera Marine Protected Area (MPA) in the Philippines. Results revealed exceptionally high fish species diversity, enabling Blue Finance to track conservation outcomes against key performance indicators.

More information

Context:

In collaboration with governments, Blue Finance co-manages a network of MPAs across the globe, working to restore degraded marine habitats and improve livelihoods. At the Puerto Galera site they aim to promote the recovery of coral and fish after the habitat was degraded by unsustainable fishing activities and various physical assaults. Monitoring recovery is key to determining if management methods are working, but monitoring fish community recovery using conventional diver surveys often misses cryptic species and is very resource intensive. A more comprehensive view of biodiversity was needed to assess MPA effectiveness.

Our role:

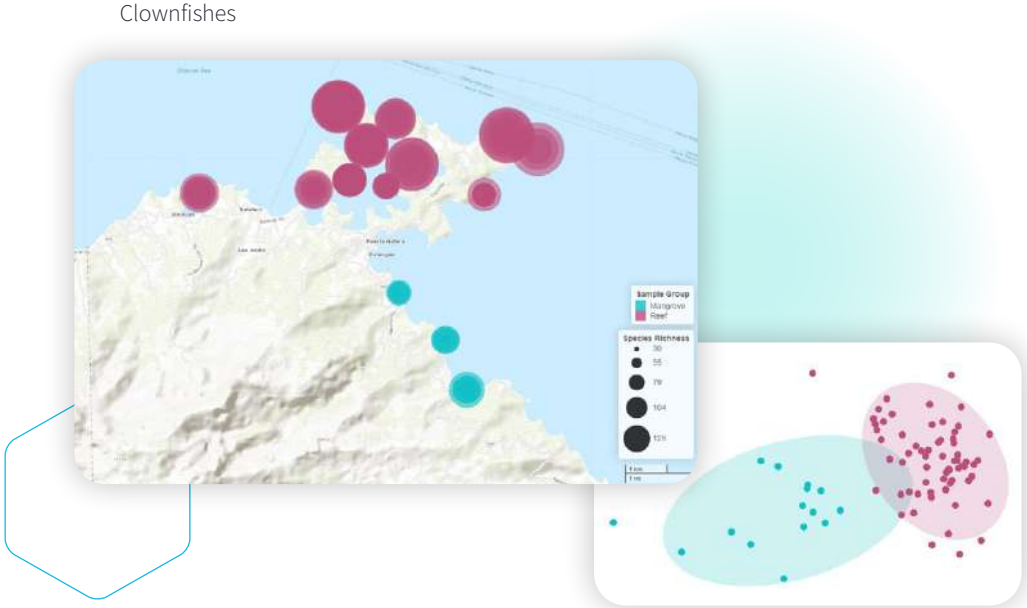
In 2022, Blue Finance used NatureMetrics service to sample both within the Puerto Galera MPA and in surrounding areas that have reduced protection status. Analysis of the samples found incredibly high species diversity, detecting over 500 fish taxa.

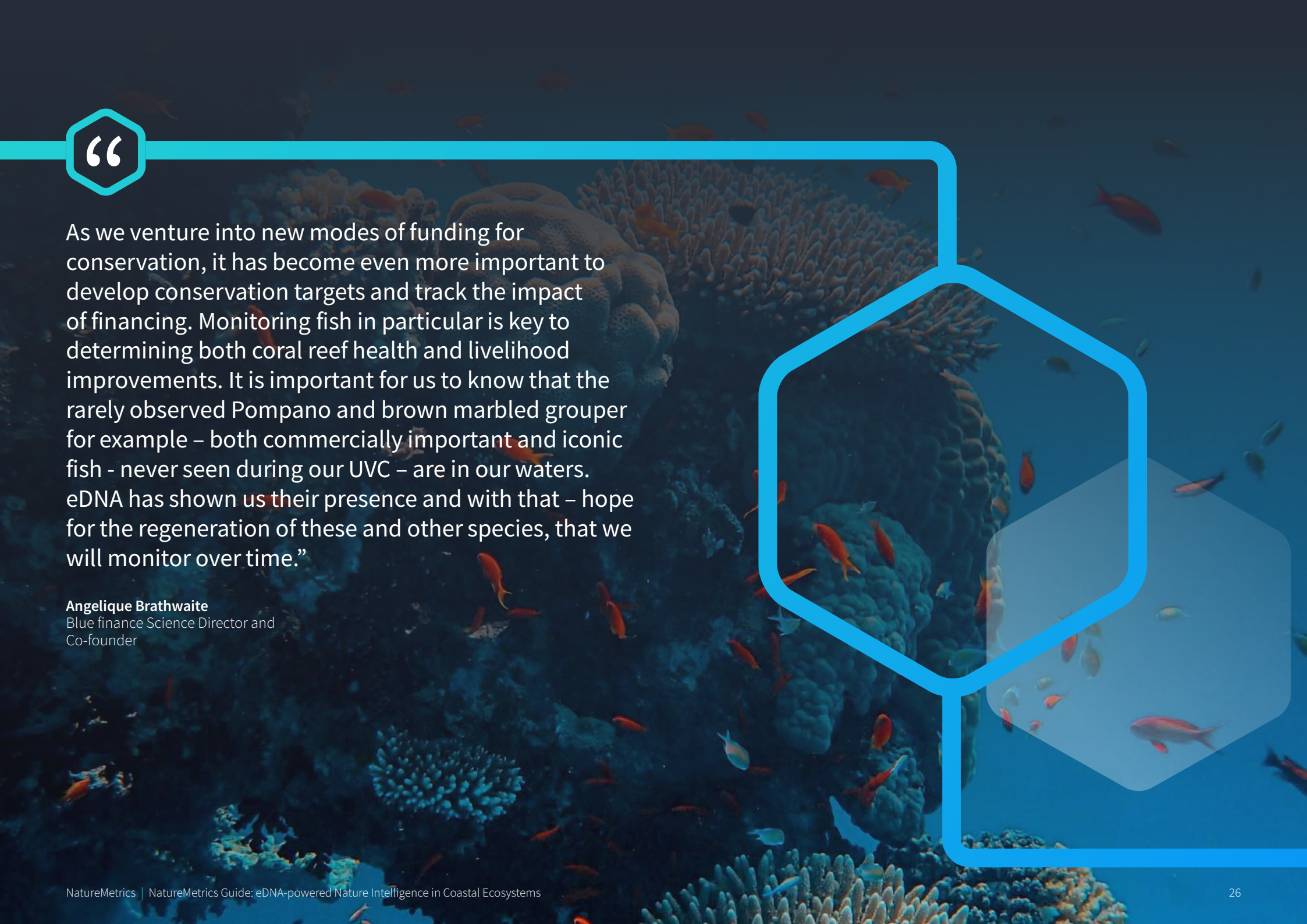
The key insights:

- The mangrove and coral reef environments supported clearly distinct species assemblages of fish.
- Species richness was greater in and around the reef MPA compared to the mangrove conservation area.
- Reef specialists included:
  - Scaridae = Parrotfish
  - Acanthuridae = Tangs, surgeonfishes and unicornfishes
  - Pomancentridae = Damselfishes and Clownfishes

The impact:

The eDNA data provided Blue Finance with a comprehensive baseline of fish diversity against which to track recovery of the ecosystem over time. Via the NatureMetrics Intelligence Platform, Blue Finance will be able track multiple performance indicators on reef health and fish population improvements, validating their work to donors such as the Global Fund for Coral Reefs. Ongoing eDNA monitoring will strengthen Blue Finance's adaptive, evidence-based management of the site.





As we venture into new modes of funding for conservation, it has become even more important to develop conservation targets and track the impact of financing. Monitoring fish in particular is key to determining both coral reef health and livelihood improvements. It is important for us to know that the rarely observed Pompano and brown marbled grouper for example – both commercially important and iconic fish - never seen during our UVC – are in our waters. eDNA has shown us their presence and with that – hope for the regeneration of these and other species, that we will monitor over time."

Angelique Brathwaite
Blue finance Science Director and Co-founder

“The world is starting to wake up to the biodiversity crisis and we finally have the tools to understand if the actions being taken are having an impact, especially in the marine space where monitoring has always been a challenge.

NatureMetrics is working closely with those leading the way in marine conservation, providing essential tools for practitioners and managers to assess and understand the impact of their actions to preserve marine biodiversity.

It is a rewarding challenge for me and my team to navigate the complexities of marine surveys, with a focus on results, and we are excited to be now supporting many marine conservation projects to be more measurable and thus impactful.”

Benjamin Barca
Head of Conservation
NatureMetrics

Endnotes

1 https://oceanriskalliance.org/

2 Manuel Barange; Tarûb Bahri; Malcolm C. M. Beveridge; K. L. Cochrane; S. Funge Smith; Florence Poulain, eds. (2018). ***Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options.*** Rome: Food and Agriculture Organization of the United Nations. ISBN 978-92-5-130607-9. OCLC 1078885208

Find out how we can help you

Samantha Howlett
Account Executive - Conservation
samantha.howlett@naturemetrics.co.uk

Clara Johnston
Account Executive - Marine
clara.johnston@naturemetrics.co.uk

Pippa Howard
Chief Nature Strategist
pippa.howard@naturemetrics.co.uk

Benjamin Barca
Head of Conservation
benjamin.barca@naturemetrics.co.uk

Krystle Robson
Head of Industrials Offshore
krystle.robson@naturemetrics.co.uk

Natalie Swan
Account Executive - Conservation
natalie.swan@naturemetrics.co.uk

Nicole Yeomans
Account Executive - Marine
nicole.yeomans@naturemetrics.co.uk

Laura Plant
Business Development Director
laura.plant@naturemetrics.co.uk

About NatureMetrics

NatureMetrics is a world leader in delivering nature data and intelligence. We use cutting-edge technology to generate biodiversity data at scale using environmental DNA.

We make biodiversity measurable and support business to transition to a nature positive economy by providing the data with which to drive good decisions for business and nature. Our mission is to transform the scale, comprehensiveness and accessibility of biodiversity data around the world, creating a comprehensive database of life on earth which will help us identify how best to protect it.

Contact us to find out more:

sales@naturemetrics.com

UK Office
1 Occam Court, Surrey Research Park,
Guildford, GU2 7HJ, United Kingdom

North America Office
590 Hanlon Creek Boulevard, Unit 11,
Guelph, Ontario, N1C 0A1, Canada

naturemetrics.com