The Solution: NPA's Reporting Framework & eDNA

NorthPeak Advisory

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This paper delves into NPA's proprietary Biodiversity Measurement & Reporting Framework (Framework). As outlined in "*The Problem: Current Data Collection & Analysis Practice*", various biodiversity metrics and assessment tools have been developed for corporates and investors to monitor their biodiversity impacts, with a particular emphasis on a "state of nature" measure. However, **the market's current understanding of the state of nature involves simplistic measures** of habitat attributes and species occurrence, which **do not capture the intricate ecosystem processes underpinned by biodiversity or provide a consistent method for monitoring changes in the state of nature**.

Our Framework **standardises and quantifies key biodiversity variables into a systematic measure of biodiversity patterns across different spatial scales and organisms**. We believe our Framework **bridges the gap between ecological science and corporate sustainability reporting**, allowing market participants to effectively and accurately meet increased biodiversity reporting requirements. Including the Taskforce on Nature-related Financial Disclosures, Science-Based Targets for Nature, and the Corporate Sustainability Reporting Directive.

NorthPeak Advisory's Biodiversity Measurement & Reporting Framework (Species Level Information)

Our Framework goes beyond basic species occurrence measures, such as Mean Species Abundance ('MSA'), and is based on the concept of Essential Biodiversity Variables (EBVs)[1][2]. In the scientific community, EBVs have been primarily used to assess and report broad-scale changes in biodiversity at the national level[3]. It **delineates multiple biodiversity indicators that measure species diversity across various natural markers**, enabling market practitioners to select appropriate biodiversity indicators, customise analyses to their specific project requirements, **accounting for local operational and environmental contexts**, and ultimately meet evolving reporting obligations.

The **current version of the Framework is focused on the different aspect of species diversity and specifies up to four taxonomic markers**, accompanied by a unique set of biodiversity indicators. Species diversity refers to the variety of species within a particular ecosystem, covering not just the number of different species but also different traits or characteristics present within a biological community or population.

The different markers and metrics used in our Framework are summarized in the following table:

	Markers	Metrics	Metric Summary
Species Diversity	Plants Fungi Vertebrates Microorganisms	Alpha & Gamma Diversity	Diversity of species considering both their number and sample richness Alpha diversity covers a specific area whereas Gamma diversity covers a broader region
		Functional Diversity	The range of different activities and roles that species perform in an ecosystem
		Species Richness	Relative density of species present in an ecosystem
		Conservation Status	The likelihood of species, both threatened and invasive, becoming extinct

[1] GEO BON strategy for development of essential biodiversity variables version 1 - produced by GEO BON management committee Oct 2015
[2] Pereira, H.M., Ferrier, S., Walters, M., Geller, G.N., Jongman, R.H.G., Scholes, R.J., Bruford, M.W., Brummitt, N., Butchart, S.H.M., Cardoso, A.C., et al., Essential Biodiversity Variables. Science 339, 277–278, 2013.
[3] Eren Turak, James Brazill-Boast, Tim Cooney, Michael Drielsma, Jocelyn DelaCruz, Gillian Dunkerley, Miguel Fernandez, Simon Ferrier, Mike Gill, Hugh Jones, Terry Koen, John Leys, Melodie McGeoch, Jean-Baptiste Mihoub, Peter Scanes, Dirk Schmeller, Kristen Williams, Using the essential biodiversity variables framework to measure biodiversity change at national scale, Biological Conservation, Volume 213, Part B, 2017, Pages 264-271.

The **combination of these metrics and markers provides a more comprehensive understanding of species diversity rather than focusing purely on species abundance**. The appendix provides a short summary of these different metrics, whilst the full descriptions and mathematical details can be found in Mynott et al. (2024)[4].

eDNA – The Differentiator

Not only does our Framework result in a more comprehensive and holistic measure of biodiversity compared to existing approaches but it also **circumvents traditional challenges[5] associated with biodiversity data collection and sampling through the innovative use of eDNA metabarcoding**. By utilising eDNA as the foundation of our Framework, it provides three core differentiators:

Accuracy	Simplicity	Scalability

Accuracy

eDNA is "nuclear or mitochondrial DNA that is released from an organism into the environment"[6], such as soil and water. **eDNA is a transformational tool for assessing and monitoring biodiversity**, given it allows for "rapid, cost-effective, and standardized collection of data about species distribution and relative abundance"[7]. With eDNA, you are able collect vast amounts of genetic information from a single location, with the ability to then identify species presence through isolating their unique DNA from the sample and comparing this to available databases such as the International Barcode of Life and Genbank.

You are able to run hundreds of tests from just one small sample, and it is considered to provide more **granular and accurate information than traditional methods of biodiversity sampling such as capture and release**. For example, Seymour et al (2021)[8] showed that for a site in North Wales they "observed 226 unique genera using the eDNA based approach and 83 genera using the traditional kick-netting approach", which meant that "eDNA genera accounted for 78.2% of the unique observed diversity in a given site, with traditional methods accounting for 5.9%, with an overlap between the two methods of 15.9%".

Simplicity

For simple, single site projects, **eDNA sample collections do not require any specialist assistance, making the assessment more accessible and time-efficient compared to traditional biodiversity assessments**. eDNA can also be collected from land, air and ocean realms, albeit collected through different sampling methods, allowing for comparison across multiple ecosystems and unlocking access to locations traditionally considered as "harder-to-reach".

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[4] Mynott, S., Habel, F., Visairas, M., Murray, E., A Comprehensive Multidimensional Biodiversity Framework: Bridging the Gap Between Ecological Science and Environmental Economics, Preprint, 2024

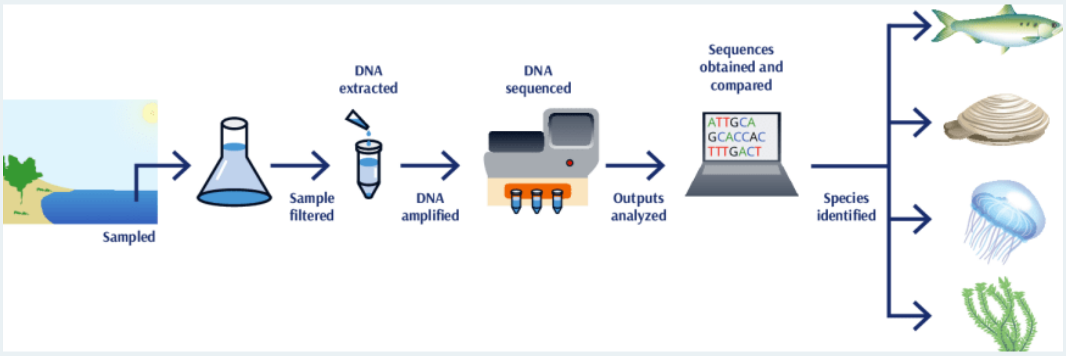
[5] Traditional challenges have included the ability to collect information from more remote ecosystems such as deep ocean environments, as well as disruptions potentially caused to the location / sampling site when conducting measurements

[6] https://www.usgs.gov/special-topics/water-science-school/science/environmental-dna-edna#:~:text=Environmental%20DNA%20(eDNA)%20is%20nuclear,extracellular%20(dissolved%20DNA)%20form.

[7] See above

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8093236/#:~:text=On%20average%2C%20eDNA%20genera%20accounted,found%20in%20Supplementary%20Data%201.

Figure 1 – Example of eDNA Sequencing Process



By **reducing the time and complexity of these assessments, they can also be more frequently conducted**. This allows you to essentially measure the **delta of your biodiversity impact**, with the first test acting as your "T0".

By doing so, our Framework can also be used as a means of **scientifically measuring, verifying and reporting on your efforts to conserve or restore biodiversity within a given ecosystem**.

Scalability

Finally, the National Human Genome Research Institute (2022)[9] shows that the technology used for sequencing DNA, is surpassing Moore's law. Moore's law describes a "long-term trend in the computer hardware industry that involves the doubling of 'compute power' every two years". Therefore, to have the **eDNA sequencing consistently surpass Moore's Law highlights its increasing scalability and applicability within the realm of corporate sustainability reporting**.

Statistical Considerations

Although eDNA offers the three differentiators outlined above, collecting data through soil or water sampling, means that individual organisms are not randomly and independently being sampled. Rather, sampling is conducted based on units of soil or water, where only the presence or occurrence of a species is recorded. A **key challenge for practitioners is that, despite the thoroughness of eDNA analysis, capturing the full range of species and traits is often limited by the quantity and quality of the samples, which can be restricted by practical or financial constraints**.

To mitigate potential data limitations and ensure that biodiversity metrics are comparable across datasets, sampling effects must be standardized. We adopt the methodology discussed and explained in Mynott et al. (2024)[10] which assesses data completeness and allows comparison between habitats using sample size. The calculations and analysis will fully be illustrated and explained in the next and final instalment of this series.

[9] https://www.genome.gov/about-genomics/fact-sheets/DNA-Sequencing-Costs-Data
[10] Mynott, S., Habel, F., Visairas, M., Murray, E., A Comprehensive Multidimensional Biodiversity Framework: Bridging the Gap Between Ecological Science and Environmental Economics, Preprint, 2024

Conclusion

This paper presented a **practical yet sophisticated method for corporates and financial institutions to monitor and address their biodiversity impacts**. By leveraging technologies like eDNA metabarcoding alongside established statistical methods, our framework not only enhances the measurement of biodiversity but also tailors these methods to fit corporate and investor needs effectively.

In the last instalment in this series, we aim to elaborate on the practical applications of these biodiversity metrics in conservation and corporate strategies, ensuring they are adaptable and relevant across various ecological and operational landscapes.

This ongoing work underscores our commitment to bridging the gap between theoretical biodiversity concepts and their practical applications, ultimately contributing to more informed and effective environmental stewardship.

Appendix – NPA’s Framework

Alpha & Gamma Diversities are terms used in ecology to describe different levels of biodiversity within a given area or among multiple ecosystems.

- **Alpha diversity** refers to the species diversity within a particular area, community, or ecosystem, and is usually expressed by the number of species (i.e., species richness) in that habitat adjusted for abundance. It provides a snapshot of the biological complexity within a single ecosystem without considering the relationships between ecosystems. Alpha diversity can also encompass the evenness of species distribution, which reflects how evenly the individuals are distributed among the species present in the habitat.

- **Gamma diversity** refers to the overall diversity of different ecosystems within a larger geographic area that encompasses multiple habitats or ecosystems. It represents the total species diversity across all the ecosystems within the region. It is especially relevant in conservation biology and landscape ecology, as it helps ecologists understand how different ecosystems contribute collectively to regional biodiversity. By studying gamma diversity, conservationists can prioritize efforts to preserve areas that contribute significantly to regional biodiversity, ensuring the protection of species that depend on diverse and interconnected habitats. This approach is particularly important in regions undergoing rapid environmental changes or facing intense human activity, where holistic strategies are needed to maintain ecological integrity and biodiversity.

Functional diversity refers to the range and value of various traits and functions performed by organisms within an ecosystem. It encompasses the variety of biological processes, functions, and characteristics of different species in an ecological community, highlighting the roles these species play in maintaining ecosystem health and stability.

Functional diversity is crucial because it encompasses the different biological functions that species perform, which are vital for ecosystem health and resilience. Functional diversity provides a nuanced view of biodiversity that emphasizes ecological function rather than just species presence, helping ecologists understand more about ecosystem resilience and stability.

Species Richness is a simple biodiversity metric that refers to the total number of different species present in a specific ecological community or habitat. It is one of the simplest and most fundamental components of biodiversity, providing a straightforward count of species without accounting for the abundances of individual species. However, species richness alone doesn't provide information about the relative abundances of species or their ecological interactions. It simply tallies how many different species exist in a given area, which can vary widely depending on geographical location, habitat type, and environmental conditions. For a more comprehensive understanding of biodiversity, species richness is often analysed alongside other measures such as species evenness (and species diversity indices that combine richness and evenness.

Conservation Status, and similar to Species Richness, track the number and status of endangered or alien invasive species, respectively. This status provides critical information about the overall health and stability of species populations and is crucial for guiding conservation efforts and resource allocation. Conservation statuses are typically assigned based on scientific data about species abundance, distribution, population trends, and threats facing the species. For endangered species, the analysis often uses the International Union for Conservation of Nature (IUCN) Red List of Threatened Species while invasive alien species are identified through genetic markers using the Global Invasive Species Database maintained by the IUCN.

About NorthPeak Advisory

NorthPeak Advisory is a boutique Sustainability advisory firm supporting asset managers and corporates across all stages of sustainability integration. We partner with our clients to develop industry-leading, streamlined solutions that enhance the efficiency of sustainability efforts, turning data and environmental science into strategic business advantages.

The shifting ESG and sustainability landscape is unpredictable with new challenges are constantly arising. From industry leading double materiality assessments for CSRD, creating bespoke responsible investment strategies and developing a cutting-edge scientific framework for the highest standard in biodiversity measurement and tracking, we stay on the front edge of sustainable transformation and constantly innovate to incorporate the latest data-led approaches into the development of our solutions.

As a signatory to the UN-Supported Principles for Responsible Investment ("PRI"), NorthPeak Advisory is a supporter of "SPRING", a PRI stewardship initiative for nature. We hope that our biodiversity solutions will support the institutional investors in using their influence to halt and reverse global biodiversity loss by 2030.

Benjamin Stone, Associate

Benjamin works as part of the Advisory Team, playing a leading role within client engagements. His areas of focus include conducting investment strategy ESG and Responsible Investment assessments, creating bespoke ESG integration frameworks, leading ESG Training sessions, ensuring alignment with both regulatory and reporting requirements, such as EU SFDR, UN PRI, TCFD, and GRESB. Benjamin has a strong understanding of responsible investment, and his extensive experience allows him to build tailored solutions that are aligned with a client's investment strategy and asset class.

Benjamin holds a first-class BSc in Politics and History from the London School of Economics and Political Science. He also holds the CFA Certificate in ESG Investing.