The business case for investing in biodiversity data

Fevziye Hasan[1], Jakob Nyström[2], Per Alström[2], Carina Andersson[3], Louise A. Ashton[4], David M. Baker[4,5,6], Michael J. W. Boyle[4], André P. da Silva[7], Mats Eriksson[1], Robert M. Goodsell[8], Emma Granqvist[8], Alice C. Hughes[9], Alice Högström[10], Veronika A. Johansson[8,11], Olga Vinnere Pettersson[12,13], Fabian Roger[14], Fredrik Ronquist[8], and Tomas Roslin[15,16]

Affiliations

[1] Museum of Evolution, Uppsala University, Norbyvägen 16, 75236 Uppsala, Sweden

[2] Evolutionary Biology Centre, Uppsala University, 75236 Uppsala, Sweden

[3] Knowit AB, Stockholm, Sweden

[4] School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

[5] Swire Institute of Marine Science, University of Hong Kong, Hong Kong SAR, China

[6] Archireef Ltd, InnoCentre, Tat Chee Road, Kowloon Tong, Hong Kong SAR, China

[7] Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden

[8] Department of Bioinformatics and Genetics, Swedish Museum of Natural History, Box 50007, SE-104 05, Stockholm, Sweden

[9] School of Biosciences, University of Melbourne, Victoria, Australia

[10] Sveaskog, Wallingatan 2, SE-111 60, Stockholm, Sweden

[11] Global Biodiversity Information Facility (GBIF) Sweden, Stockholm, Sweden

[12] Uppsala University, Disciplinary Domain of Medicine and Pharmacy, Faculty of Medicine, Department of Immunology, Genetics and Pathology

[13] Uppsala University, Science for Life Laboratory, SciLifeLab

[14] DNAir AG, Zurich, Switzerland

[15] Ecosystems and Environment Research Programme, Faculty of Biological and Environmental

Sciences, PO Box 65 (Viikinkaari 1), FI-00014 University of Helsinki, Finland
[16] Swedish University of Agricultural Sciences (SLU), Department of Ecology, Ulls väg 18B, 75651, Uppsala, Sweden

Corresponding author: Fevziye Hasan - fevziye.hasan@em.uu.se

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Conflict of Interest

The authors declare no competing interests, financial or otherwise. For transparency, VAJ is employed by GBIF. DMB and F. Roger are affiliated with nature-tech companies (Archireef Ltd and DNAir AG), and EG and F. Ronquist are associated with Mistra FinBio. FH hopes to develop a not-for-profit organisation based on the biodiversity data broker model described in this paper.

Key Words

Business and biodiversity, biodiversity data gap, biodiversity finance gap, biodiversity crisis, biodiversity informatics

Highlights

- The biodiversity crisis is also a business crisis, with global economic losses exceeding $5 trillion annually. Biodiversity loss generates risks, opportunities, and regulatory requirements that businesses cannot address without reliable biodiversity data.

- Significant gaps in biodiversity data and taxonomic expertise prevent businesses from fully understanding their biodiversity dependencies, impacts, risks, and opportunities, constraining nature-based solutions and sustainability strategies.

- The methods and infrastructure to deliver high-quality open biodiversity data already exist through GBIF; what is urgently needed is sustained financial investment in collection, standardisation, and mobilisation.

- We identify solutions for financing biodiversity data at scale: businesses share their own biodiversity data or invest via a trusted biodiversity data broker that facilitates sustained data mobilisation to GBIF.

Abstract

Biodiversity loss threatens ecosystems and economic stability, creating an urgent need for biodiversity data. Businesses require these data to understand their impacts and dependencies, assess risks and opportunities, meet regulations, and inform nature-based solutions (NbS). Significant challenges remain: the biodiversity data gap, limited expertise in translating raw data into business use cases, and insufficient financing for consolidating data within a reliable open infrastructure like the Global Biodiversity Information Facility (GBIF). Here, we explore biodiversity data origins and how targeted investment, AI, and automation can address the biodiversity data gap faster, cheaper, and more reliably at scale. We propose a financing model for businesses to invest in biodiversity data,

embedded within a broader framework addressing the data gap, with case studies illustrating practical application.

Business applications of biodiversity data

The biodiversity crisis is a business crisis (1) with global economic losses already exceeding $5 trillion annually (2). Biodiversity underpins the **ecosystem services** (see Glossary) businesses depend on, from pollination to climate regulation to food security and disease control (3,4). As a core component of natural capital (5,6), biodiversity loss creates escalating risks with irreversible consequences as planetary boundaries are transgressed (7,8). These risks have catalysed international action through the **Global Biodiversity Framework (GBF),** nature's "Paris moment,"(9) with 23 targets leading to four broad goals for halting and reversing biodiversity loss by 2050. Yet, none of these targets can be implemented or tracked without **biodiversity data** (10).

Just as carbon markets emerged under the Paris Agreement, biodiversity markets are now developing as businesses recognise that carbon is only one aspect of nature. The evolving umbrella of nature markets acknowledges that climate and ecosystems are interdependent, creating new opportunities (11–13). For example, businesses investing in **Nature-based Solutions (NbS)**, like biodiversity credits, aim to protect biodiversity, enhance ecosystem services, and mitigate climate risks. But scaling these solutions remains challenging due to difficulties in measuring biodiversity outcomes and securing long-term investment (14). Inadequate baseline biodiversity data, monitoring, and auditable records make validating claims difficult (15,16), and the absence of centralised oversight further risks false claims and greenwashing (17).

The World Bank estimates that collapsing ecosystem services could cost $2.7 trillion annually by 2030 (18). Without adequate data, businesses cannot anticipate sudden, irreversible ecosystem changes that cause major environmental, social, and financial losses (19), disrupting the **supply chains** on which businesses depend. Target 15 of the GBF encourages businesses to measure biodiversity risks, dependencies, and impacts, and increasing regulatory pressure requires biodiversity data for both mandatory and voluntary reporting. For example, the Environment Act 2021 (UK) was the first to mandate Biodiversity Net Gain (BNG), requiring measurable biodiversity improvements (20), while the EU's Corporate Sustainability Reporting Directive (CSRD) requires disclosure of nature-related impacts and dependencies (21). Despite recent reductions in disclosure requirements (22), companies that take their nature-related financial risks seriously continue to adopt voluntary frameworks like the **Taskforce on Nature-related Financial Disclosures (TNFD)** to maintain transparency and stakeholder trust (23).

Businesses need biodiversity data to answer three critical questions: what are their impacts and dependencies, and where do risks and opportunities lie? Most companies cannot answer them (24). While biodiversity-related financial risks are acknowledged at macro scales, company-level data remains sparse across industries (25). The challenge extends beyond sectors with obvious dependencies like agriculture, mining, forestry, and fisheries. Agriculture occupies over 50% of Earth's habitable surface, representing both the primary driver of biodiversity loss and greatest opportunity for nature markets. Yet 30% of cultivated lands lack biodiversity data, with many areas having no new data for over a year (26).This data scarcity leaves companies unable to measure supply chain risks, identify impact blind spots, or identify harmful subsidies. European primary sector entrepreneurs underestimate their impacts due to short-term economic incentives and national contexts (27). Companies with complex global supply chains in electronics, automotive, and textiles face even greater difficulty tracking biodiversity relationships, and understanding what to measure and how compounds this challenge.

Unlike carbon accounting's standardised CO_2-equivalents, biodiversity lacks a unified metric (28). Biodiversity data are highly context-dependent, encompassing genetic, species, and ecosystem diversity (29,30). Businesses are left grappling with nothing less than one of humanity's deepest questions: how to define and quantify biodiversity. This needs guidance. Without appropriate data and expertise, companies may misjudge their economic dependencies on biodiversity. Despite a growing **nature-tech** sector, businesses face a "**nature data gap**" rendering any subsequent "**nature intelligence**" unreliable (31), limiting innovation and undermining sustainability strategies. The TNFD has proposed a "Nature Data Public Facility" to provide decision-useful data for corporate reporting (32). However, this risks perpetuating data fragmentation, which produces unreliable models and undermines any science-based understanding of how businesses relate to nature.

The biodiversity data gap

The **biodiversity data gap** stems from inadequate understanding of the importance of, and bottlenecks in, collecting, standardising, and mobilising biodiversity data to a reliable central infrastructure. The Global Biodiversity Information Facility (GBIF) was established in 2001 to address global biodiversity information sharing (33). Today, GBIF hosts over 3.5 billion records from 2,574 publishers across 68 countries and 42 participant organisations (34). While GBIF represents an extraordinary scientific achievement, chronic underfunding means it cannot meet demands from biodiversity regulation and nature markets. Global biodiversity remains largely terra incognita, with data fragmented and uneven across taxa, ecosystems and regions. Birds dominate with 65.3% of records, despite representing just 0.5% of known species. Most data come from high-income countries, leaving biodiversity-rich regions underrepresented. Spatial coverage has improved from 6.2% of Earth's terrestrial surface in 2015 to 15.5% in 2025 at 5 km resolution, but major gaps persist in the world's most biodiverse regions (35).

Marine and freshwater habitats remain underrepresented, with coverage of merely 3.4-10.7%. Coral reefs have been sampled across only 11% of their extent, and freshwater ecosystems face similar deficits (35). Sampling is biased towards accessible areas: roads, wealthy nations, and established research infrastructure. The U.S. contributes 26% of reptile records but hosts less than 5% of global reptile diversity. Plant data from the Botanical Information and Ecology Network (BIEN) cover around 290,000 species, but gaps remain across Southeast Asia, Central Asia, and North Africa. Of

144,239 IUCN-assessed species, 28,713 lack geographic data entirely, and 83% of animals are mapped with coarse polygons (35).

Data sovereignty further complicates progress. Many biodiversity-rich regions treat biodiversity data as a national resource rather than sharing it openly. This creates problems because these regions often anchor global supply chains. For example, Malaysia produces 26% of the world's palm oil, a USD 16.1 billion industry (36), yet Malaysia's Biodiversity Information System (MyBIS) restricts data access. As a result, businesses buying palm oil cannot verify sustainability claims or biodiversity risks. Additionally, biodiversity data are essential to verify the value of NbS projects like tropical rainforest and mangrove restoration or biodiversity credits. Access to such data would unlock better risk management and economic opportunities. Governments recognising this accelerates progress, with South Korea and Japan reaching nearly 100% coverage by 2025 (35).

The CBD encourages parties to join GBIF (37), with some support for international capacity building programmes in developing regions. For example, Colombia, the world's second most biodiverse country, now leads in businesses publishing biodiversity data, with over 340 datasets and 3.6 million records uploaded through raising awareness via the National Business Association of Colombia (ANDI). This has strengthened Colombia's biodiversity data and increased temporal coverage, giving Colombian businesses transparency and market advantages unavailable in data-poor regions. Without such shared resources, businesses cannot gauge the status quo of biodiversity they depend on or evaluate alternative actions for strategic planning. Yet closing the data gap requires understanding the expertise, infrastructure, and standardisation processes needed to collect quality raw biodiversity data in the first place.

From raw biodiversity data to data products

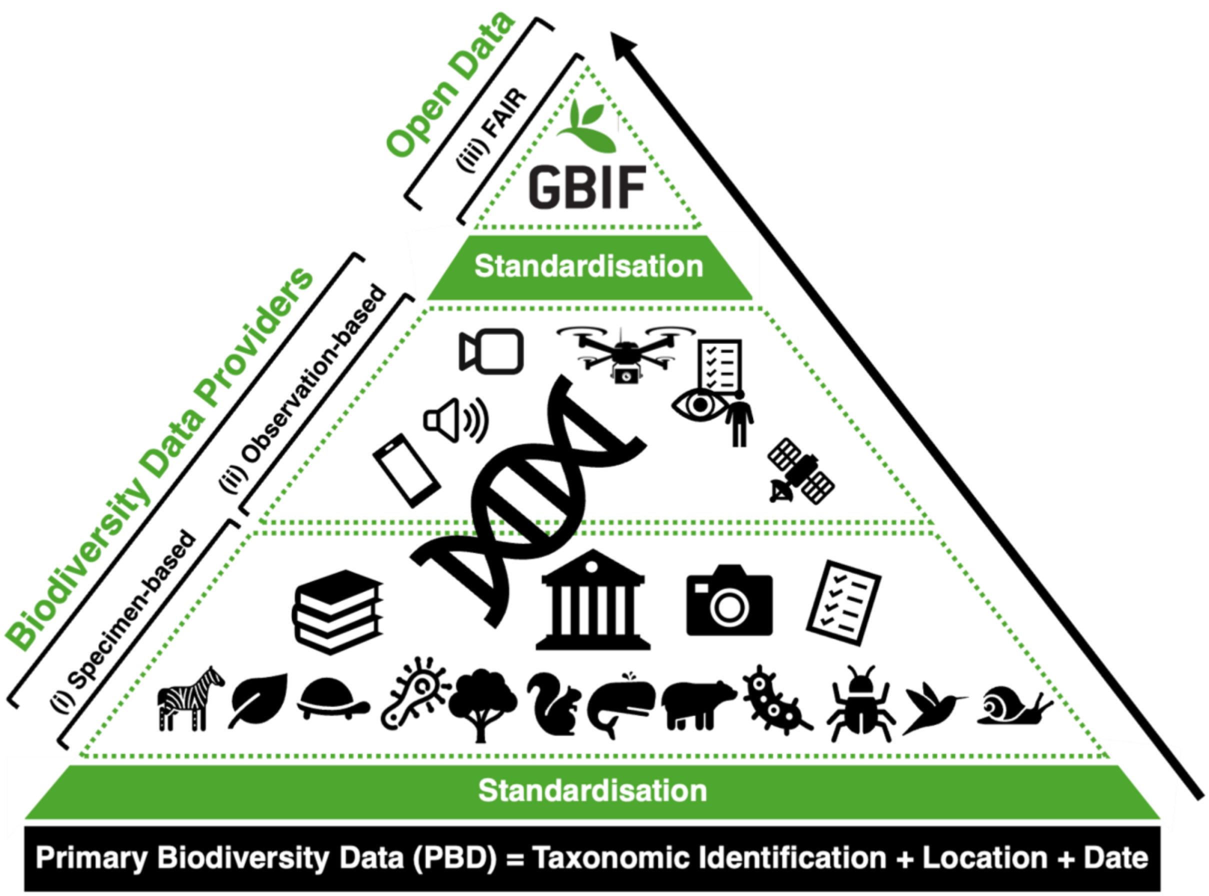

Figure 1. The origins of primary biodiversity data. The biodiversity data landscape forms a structural pyramid in which each tier depends on the stability and investment of the one beneath it, with bottlenecks at every level that are unknown to business stakeholders. Primary biodiversity data, also known as occurrence data, consist of taxonomic identification, location, and date, representing the most useful data type requiring investment. To make these data available for businesses, biodiversity data providers must first standardise sampling protocols, then collect data, standardise the data according to metadata standards, and finally mobilise data as FAIR and open data accessible through GBIF. (i) Specimen-based data are physical vouchers in natural science collections: type specimens (the name-bearers for species), preserved organisms, tissue and genetic samples, living collections (e.g., botanical gardens), and archival materials (journals, checklists, notes, photographs). These provide the taxonomic reference framework for all biodiversity information. (ii) Observation-based

data are records of species encounters generated through field surveys and sensor technologies: human observations using eyes, binoculars, and field notes, eDNA sequences from environmental samples, acoustic sensor recordings, camera trap imagery, citizen science observations (e.g., iNaturalist), and drone-based remote sensing data. DNA-based approaches overlap both domains, requiring physical samples for taxonomic verification. (iii) FAIR data standardisation occurs before collection (sampling protocols) and after collection (to adhere to metadata standards like Darwin Core), followed by mobilisation to GBIF's open infrastructure. Sustained investment across all layers, particularly the foundational specimen-based tier, is essential to prevent fragmentation and ensure verifiability for business use cases.

Data collection, standardisation and mobilisation

The **biodiversity data gap** reflects chronic underinvestment in generating and standardising biodiversity data from specimens and observations (Figure 1). Collecting and mobilising high-quality biodiversity data was once costly and slow, but modern technology and computing power have greatly reduced these barriers. Today, the main challenge is securing investment across the data lifecycle, from standardised collection to metadata formatting and centralised FAIR data mobilisation.

Natural science collections remedy one of the most fundamental biodiversity data gaps: the **taxonomic impediment** (38) (Figure 1). Species names are anchored to type specimens, providing reference points for collating information on what species are and do in nature. Collections also preserve decades of temporal data that establish historical baselines (39). Yet, billions of specimens in European collections alone remain undigitised (40). High-speed digitisation systems (41,42) and automated label transcription (43) now process tens of thousands of specimens efficiently. Once digitised, specimens enable essential applications: genetic data builds eDNA reference libraries, computer vision extracts trait data for modelling ecosystem services (44), and type material are references for species verification. Living collections (e.g. botanical gardens) collectively maintain about a third of described plant diversity, including threatened or extinct taxa (45). Specimen-based data provide the taxonomic reference framework upon which all observation-based technologies depend (Figure 1).

Advances in biodiversity science have driven development of scalable observation-based monitoring technologies (Figure 1). Business demand has accelerated innovation in the nature-tech sector, which attracted over USD 2 billion in investment in 2022, growing at 52% annually since 2018 (31,46). eDNA and metabarcoding enable rapid species detection, accelerating inventory of cryptic taxa like fungi and invertebrates (47,48). Passive acoustic monitoring with AI enables continuous monitoring at costs far below traditional surveys (49,50). Camera traps now extend to plants and insects (51–53) while platforms like iNaturalist leverage smartphones and deep learning to crowdsource observations (54,55). Drone sensors enable species-level identification and habitat mapping, though applications remain geographically limited (56–58). These technologies generate big biodiversity data at a fraction of the cost (59), but volume alone does not ensure utility.

Without standardisation before and after data collection, most data remain challenging to integrate (48). Data produced from different methods are difficult to compare, so metadata standards ensure raw data from diverse sources are **FAIR** (60,61). First, sampling designs need standardisation and representativeness. Coherent protocols for generating commensurate data are rapidly advancing (62,63) and to ensure representativeness, data should cover current environmental variation. Second, metadata must be standardised to enable users to retrace where, when and how data were acquired. Sampling unrepresentative subsets risks misinterpreting trends across populations and communities (64–66). Darwin Core (DwC) vocabulary, maintained by Biodiversity Information Standards (TDWG) (67) underpins this interoperability. The emerging DwC Data Package format enables publication of DwC-based datasets as Frictionless Data Packages, supporting richer, linked tables and explicit relationships (68). Domain-specific implementations include the Humboldt Extension for Ecological Inventories (69), MIxS for sequence data (70) and Camtrap DP for camera trap data (71). These align with initiatives like the Distributed System of Scientific Collections (DiSSCo) and Digital Specimen framework, advancing interoperability and supporting cross-scale integration.

For accessibility and reuse, biodiversity data must be consolidated to a single, reliable open infrastructure: GBIF. Maintaining fragmented data across multiple platforms is untenable, creating data leakage and waste. GBIF represents the clear consolidation point as the world's largest biodiversity data infrastructure. Business dependence on GBIF, including through the proposed TNFD Nature Data Public Facility (72). makes focused investment essential. However, even when standardised and mobilised to GBIF, raw biodiversity data cannot directly answer business questions about dependencies, risks, and opportunities. Translating primary data into decision-ready biodiversity data products is essential.

Decision-ready metric, models and tools

Translating biodiversity data into decision-ready products for business use cases requires metrics, models and tools. Yet without collaborative expertise of taxonomists, ecologists, developers and data scientists, data products risk being technically sophisticated but ecologically meaningless (73). Metrics reduce multidimensional biodiversity data to simpler forms. While over 2,000 terrestrial biodiversity metrics exist (74), their validity depends on data quality and interpretation. Even simple metrics such as species richness can mislead without ecological context (75). The IUCN Red List, widely used in private sector reporting, is taxonomically biased towards vertebrates, with most other taxa data deficient and assessments lacking transparency (76). Essential Biodiversity Variables (EBVs) are an example of standardised metrics (77) adopted by businesses. However, EBVs derived from remote sensing data are difficult to interpret and unreliable. Businesses increasingly turn to eDNA-based approaches for ground-truth data that provides direct, actionable biodiversity metrics (78).

Models predict future species distributions, habitat loss, and ecosystem change. Species distribution models translate primary biodiversity data into spatial forecasts, but only when ecologists guide variable selection and constraint parameterisation. This method currently represents 48% of GBIF-based methodological applications, machine learning 4.43% but growing rapidly (34). Examples used by businesses include the Biodiversity Intactness Index (BII) (79,80), and GLOBIO (81) both proposed as GBF indicators (82). However, many such global heat maps (83) are only weakly linked to evaluating specific decision impacts. Actionable data products require regional and local data to ensure high-quality analysis. BII and similar models remain largely untested for predictive performance (84,85), potentially undermining businesses' nature-related financial risks. Outside academia, nature-tech business solutions built without ecological expertise and lacking peer review or quality standards enter the market with shiny promises, making it difficult to distinguish rigorous tools from AI hype merchants (86). Business decisions based on dodgy biodiversity data products risk major negative biodiversity impact.

Tools represent the practical integration of metrics and models into operational decision support. Pl@ntNet demonstrates the full translation arc, with four million users contributing plant images that undergo AI-based identification and integration into species distribution models, yielding real-time intelligence on endangered species and richness patterns (87). Similar end-to-end pipelines are emerging for acoustic monitoring, where audio recordings from hundreds of thousands of users are processed through AI-based species identification and digital twinning to generate continuously updated species distribution maps (88). However scrupulous the methodology, models, metrics, and tools cannot escape underlying data, raising the question: how can business investment in biodiversity data be secured and incentivised?

Investing in biodiversity data

Biodiversity finance has grown steadily, with public funding unlocking private investment from US$0.1 billion in 2016 to US$1.7 billion in 2023, and US$23.4 billion flowing to NbS in the same year (97). Yet flows remain far below the US$700 billion annual gap needed to meet GBF targets, while US$840 billion annually flows to harmful subsidies (97). If just 1% of harmful subsidies were redirected to biodiversity data collection, standardisation, and mobilisation to GBIF, what could we achieve? Despite evidence for positive returns, coordinated business investment in data remains absent.

The **business case** for investing in biodiversity data has been demonstrated. GBIF delivers €3 in direct user benefits and €12 in societal value (by extension, business value) for every €1 invested (89). Scotland's biodiversity data infrastructure generates £10 to £24 per £1 invested (90), UK marine data infrastructure returns 8:1 benefit-cost ratio (91), and the Natural History Museum's £155.6 million digitisation programme is estimated to return £2 billion in economic value (92). Despite this, business investment remains negligible, widening the **biodiversity finance gap**. Private companies accounted for just 0.3% of GBIF data in 2020, publishing only 7.8 million records (93). A paradox emerges: demand for biodiversity data is increasing due to risks and regulations, yet supply remains limited because businesses underinvest in data generation. Where investment occurs, data remain siloed (94), preventing businesses from understanding financial risks at sector level (25).

Businesses end up in two categories. Companies with direct natural resource dependencies, such as agriculture, mining, and forestry, conduct mandated environmental impact assessments generating datasets that remain internal. Mobilising these to GBIF would unlock billions of records while providing sector insights at marginal cost (94). Companies with indirect dependencies in complex supply chains, such as pharmaceutical companies, electronics manufacturers, and fashion brands, lack direct biodiversity data but depend on it for supply chain risk assessment and regulatory compliance under frameworks like TNFD. For these businesses, **blended finance** models offer a solution: investing in biodiversity data providers via a trusted **biodiversity data broker** that ensures scientific legitimacy and provides auditable outcome-based certification of impact (Figure 2).

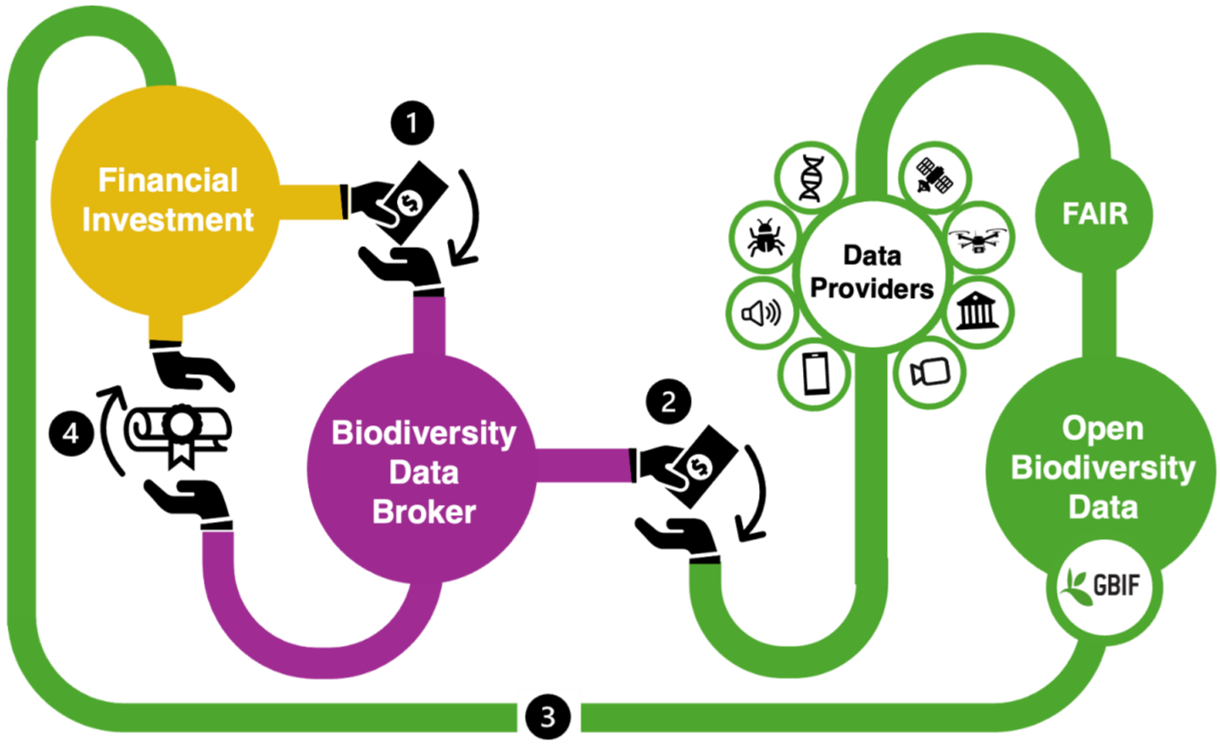

Figure 2. A biodiversity data broker model enabling blended finance and collective business investment in biodiversity data (1) Financial investment from business stakeholders (yellow) flows to a not-for-profit organisation acting as a trusted biodiversity data broker (purple). (2) The broker directs funds to biodiversity data providers (green) for primary data collection, standardisation and mobilisation to GBIF. By pooling resources and expertise, the broker ensures investments support high-quality data that serve both business and biodiversity needs, maximising return on investment. (3) Biodiversity data are published on GBIF (green), becoming openly available to all users worldwide. (4) Investors (yellow) receive outcome-based certification from the broker (purple) verifying their measurable contribution to open biodiversity data. Certification tracks the volume and quality of mobilised data, linking impact directly to each investor's financial contribution. This enables businesses to report biodiversity data contributions as measurable outcomes within sustainability portfolios, providing transparent and auditable evidence of nature-positive investment.

A framework for business investment in biodiversity data

Operationalising these investment pathways requires clarity on how biodiversity data flows from collection to business use cases. Figure 3 presents the necessary steps for generating high-quality biodiversity data that businesses depend on. The framework demonstrates that downstream business needs (models, metrics, tools for reporting and NbS) depend on solving upstream bottlenecks: biodiversity data (Figure 1) and financing pathways (Figure 2).

The two investment pathways map directly onto this system. Companies with direct natural resource dependencies can share existing data from mandatory environmental assessments. TotalEnergies (Box 1A) demonstrates how businesses can mobilise assessment data directly to GBIF. MISTRA FinBio (Box 1C) illustrates how businesses and sectors, such as Swedish agriculture, can standardise sector-specific measurements through academia-finance collaboration, producing standardised eDNA monitoring systems that draw baseline data from GBIF and maintain auditability by mobilising new data back. Alternatively, businesses can use nature-tech monitoring services like NatureMetrics (Box 1E), which offers clients the option to share data to GBIF while maintaining their own records.

The second pathway is for businesses, particularly those with indirect biodiversity dependencies, to pool investment through a trusted biodiversity data broker to finance data collection and mobilisation (Figure 2). This model has major potential for biodiversity hotspots like Sabah, Malaysian Borneo, where decades of ecological research have generated extensive datasets (Box 1B) that remain unpublished despite the region's economic importance for palm oil production. Certification-based investment can also mobilise temporal data from natural history collections at universities (Box 1D), where millions of specimens documenting economically important species require digitisation. Nature-tech companies (Box 1E) complement these efforts by filling critical data gaps through scalable monitoring technologies.

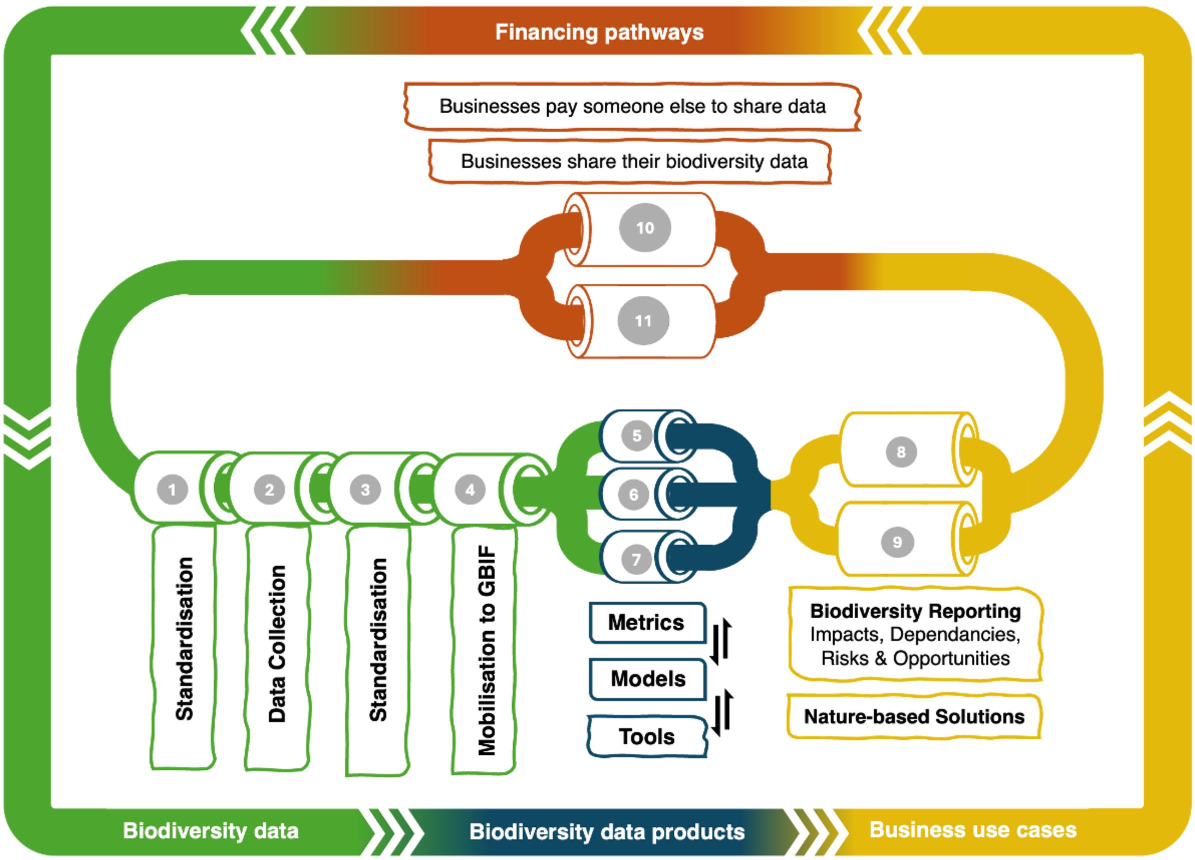

Figure 3. A conceptual framework for business investment in biodiversity data.

Biodiversity data (green) flow through standardisation and mobilisation to generate data products (blue) that enable business use cases (yellow), supported by financing pathways (orange). The framework begins with (1) data standardisation protocols established prior to collection, including sampling design and methodology; (2) data collection from diverse providers including natural science collections, environmental impact assessments, and biodiversity monitoring programmes; (3) standardisation following FAIR metadata principles and Biodiversity Information Standards (TDWG) to ensure data quality and interoperability; (4) mobilisation to GBIF, the world's largest open biodiversity data infrastructure, consolidating data into a reliable open platform. Biodiversity experts then generate data products, including (5) metrics such as Essential Biodiversity Variables (EBVs); (6) models, such as species distribution and forecasting; and (7) tools including software, digital twins and platforms for data processing and analysis, iteratively updated as new data become available. These data products enable (8) business use cases, including biodiversity reporting under mandatory and voluntary frameworks, assessing impacts, dependencies, risks, and opportunities; as well as (9) nature-based solutions (NbS) including biodiversity credits. Two financing pathways offer businesses clear routes to address the biodiversity data gap (10) businesses with direct natural resource dependencies sharing their own biodiversity data directly to GBIF; (11) businesses with complex supply chain dependencies invest in biodiversity data via trusted brokers who partner with data providers, pooling investment to fund data collection and mobilisation to GBIF at scale.

Box 1. Case studies of business investment in biodiversity data

(A) Multinational business publishing biodiversity data

Since 2018, TotalEnergies has mobilised biodiversity data from mandated environmental impact assessments to GBIF, publishing over 50,000 records from marine ecosystems. These datasets include primary biodiversity data from experts and tech, such as acoustic recordings, as well as ecological data such as habitat sensitivity metrics. By becoming a GBIF data publisher, they adhere to FAIR principles and Darwin Core standards, and align operational monitoring with sustainability reporting and regulatory compliance, including the GBF and the CSRD. They claim that partnering with GBIF has improved their auditability and stakeholder reputation, despite not publishing all operational data.

(B) Biodiversity hotspots with unmobilised data

In Southeast Asian biodiversity hotspots, decades of ecological research have generated extensive datasets that remain largely inaccessible. In Sabah, Malaysian Borneo, initiatives such as the SAFE (Stability of Altered Forest Ecosystems) experiment, funded by the Sime Darby Foundation and coordinated by Imperial College London, have produced millions of biodiversity records across taxa and land-use gradients (95). However, these remain unmobilised through global infrastructures such as GBIF, and data from other large-scale projects, including the IKEA Sow-a-Seed forest restoration initiative, are not published to GBIF. Mobilising these legacy datasets through targeted financing and governance mechanisms would provide cost-effective baselines for conservation planning, sustainable land management, and compliance monitoring, particularly in biodiversity-rich but under-resourced regions.

(C) Academia–finance partnerships for sector specific standardised biodiversity data

The MISTRA FinBio programme in Sweden shows how collaborations between academia and the financial sector can generate biodiversity data tailored to business and investment needs. FinBio tests and evaluates different methods of standardising biodiversity data collection, including eDNA sampling. One pilot project focuses on Swedish agricultural land and investigates the impact of regenerative farming practices, work that is done in collaboration with the organisation *Svensk kolinlagring*. The project aims to collect data that can be used to inform financial decision-making and support sustainability metrics based on e.g. EBVs. The project commitment to open methods and data ensures that the biodiversity information is published to GBIF, enhancing transparency and long-term utility.

(D) Natural science collections: the original biodiversity data infrastructure

Nature-tech companies provide business solutions for biodiversity measuring and reporting tailored to reporting frameworks, such as the TNFD, while both using and contributing to GBIF data. Archireef Ltd (Hong Kong), DNAir AG (Switzerland), and NatureMetrics Ltd (UK) were founded by academic experts in biodiversity science. Archireef combines modular coral restoration structures with environmental DNA, photogrammetry, and acoustic surveys to establish baselines and track ecological change in marine systems. DNAir develops airborne eDNA sensors for rapid, non-invasive biodiversity assessments in remote or sensitive terrestrial environments. Both companies draw on existing GBIF data to model baseline biodiversity of ecosystems. NatureMetrics also offers clients the option to mobilise eDNA data back to GBIF. These nature-tech companies bridge gaps in terrestrial and marine ecosystem data while demonstrating how commercial monitoring can strengthen open data available on GBIF.

Concluding remarks

Businesses need biodiversity data to assess risks and comply with regulations. Over 600 companies and financial institutions representing US$20 trillion in assets now commit to nature-related disclosure with TNFD (98), yet to our knowledge, there is little concerted effort to address this issue head on and find financing solutions to the data gap. How can we ensure businesses' natural-related financial risks are meaningful without auditable biodiversity data? This is not a technical problem. The methods, protocols, and infrastructure exist. The constraint is educating business stakeholders about the upstream bottlenecks in consolidating biodiversity data (Figure 1), financing pathways for coordinating investment (Figure 2), and how this impacts them (Figure 3), enabling meaningful action to activate the system at scale.

Biodiversity loss is urgent. National security frameworks now recognise biodiversity loss as a serious threat to food security, water availability, public health, and disaster protection (100). In 2018, Barbier et al. (96) asked how to pay for saving biodiversity; the GBF represents progress, but the next question is: how to pay for the biodiversity data needed to save it. Currently, businesses acknowledge the data gap but investment does not follow. Business and biodiversity can achieve mutual profitability through a shift from transactional interactions to genuine partnerships, driven by enlightened self-interest, market forces, and strategic collaboration (99). This is particularly critical as we enter an increasingly data-driven economy with digital twins and AI systems. Biodiversity data investment represents a no-regret strategy that gains value through accumulation and compounds over time. Realising this requires collaborative forums where ecologists and business stakeholders bridge disciplinary divides whilst maintaining scientific rigour. Biodiversity data can establish common ground between these worlds. Questions remain about optimal collaboration mechanisms, standardisation frameworks, and investment incentives (see Outstanding questions).

Outstanding questions

1. What is the economic value of biodiversity data at company, sector, regional, and global levels, and how does this value change over time? Understanding biodiversity data's economic value could justify investment and demonstrate tangible returns to businesses.

2. How can scaling biodiversity data collection for business needs simultaneously address the taxonomic impediment by training new taxonomists and developing AI tools? Can strategic investment reverse the "double extinction" by building both taxonomic capacity and biodiversity knowledge?

3. Can businesses establish collective mobilisation targets, such as 10 billion primary biodiversity records by 2050, with sector-specific milestones that align financial investment with GBF goals? Such targets could guide investment opportunities and priorities across industries with different dependencies and measure progress.

4. Could policy frameworks mandate that businesses, particularly from primary industries, share biodiversity data with GBIF or demonstrate investment via biodiversity data brokers? This could accelerate data mobilisation at scale and encourage countries to share their data ensuring more economic opportunities for biodiversity-rich regions.

5. Can the number of primary biodiversity data points collected and mobilised to GBIF serve as a useful complementary positive action and measurable metric for business engagement with biodiversity?

6. What governance structures ensure biodiversity data brokers and their certification maintain scientific legitimacy, prevent greenwashing, and deliver auditable outcomes that businesses and regulators trust? The credibility and effectiveness of the broker model depends on

transparent standards and independent verification.

7. What forums best facilitate collaboration between biodiversity scientists and businesses? Can biodiversity data serve as a common language bridging ecologists, economists, and business stakeholders toward coordinated action for biodiversity?

Glossary

1. Biodiversity data

Primary biodiversity data, also known as occurrence data, includes taxonomic identification, geographical location, and date of observation or collection. This data type is essential for biodiversity data products.

2. Biodiversity data broker

A not-for-profit organisation that facilitates blended finance and collaboration between businesses, de-risking individual investment towards biodiversity data. It channels financial resources and technical support to verified biodiversity data providers to collect, standardise, and mobilise biodiversity data into GBIF, ensuring data quality, auditability, certification, and equitable access.

3. Biodiversity data gap

Also referred to as the "nature data gap", the persistent gap in taxonomic, ecosystem, geographic, and temporal biodiversity data available through open infrastructure.

4. Biodiversity finance gap

The difference between financial resources required to conserve and sustainably manage biodiversity and current investment. Estimated at $700 billion annually, reflecting chronic underinvestment constraining progress toward global biodiversity targets..

5. Blended finance

Investment from multiple sources to reduce risk for individual investors.

6. Business case

Justification for proposed action, considering financial, social, and environmental factors, outlining expected benefits, costs, and impact to support decision-making.

7. Ecosystem services

Benefits businesses and society derive from healthy ecosystems, including clean water, pollination, carbon sequestration, and soil fertility, that support operations, supply chains, and resilience.

8. FAIR data

Findable, Accessible, Interoperable, and Reusable data. FAIR data principles improve transparency, reproducibility, and integration across datasets and sectors.

9. Kunming-Montreal Global Biodiversity Framework (GBF)

A 2022 global agreement to halt and reverse biodiversity loss by 2030 and achieve living in harmony with nature by 2050. It sets four goals and 23 targets, including protecting 30% of land and sea, restoring ecosystems, and mobilising USD 200 billion annually, emphasising open, high-quality biodiversity data for monitoring progress.

10. Nature Intelligence

Analytic outputs businesses use to understand and report on biodiversity impacts, dependencies, risks, and opportunities, leveraging data products such as metrics, models, and tools to inform decisions while measuring and mitigating impacts.

11. Nature-tech

Tech companies delivering solutions for biodiversity data collection and analytics, including hardware (camera traps, drones, acoustic monitoring, eDNA sampling) and software providing metrics, models, and tools for business use.

12. Nature-based Solutions (NbS)

Actions that protect, restore, or sustainably manage ecosystems while delivering biodiversity benefits to people, such as green infrastructure, reforestation, and biodiversity credits. NbS achieve multiple co-benefits including protecting biodiversity, enhancing ecosystem services, and mitigating climate risks.

13. Supply chain

The network of organisations, activities, and resources involved in producing and delivering goods or services, where biodiversity and ecosystem services underpin materials, influence risks, and shape sustainable strategies. For example, cocoa supply chains depend on pollination and forest services; biodiversity loss can reduce yields, disrupt production, and increase costs.

14. Taskforce on Nature-related Financial Disclosures (TNFD)

An international framework helping companies and investors report on nature-related financial risks, opportunities, and dependencies to support sustainable decision-making. Leading a new initiative called “the Nature Data Public Facility”.

15. Taxonomic impediment

A CBD term describing knowledge gaps in taxonomic systems, shortage of trained taxonomists, and resulting impacts on our ability to identify, monitor, and value biodiversity. With millions of species undescribed and too few taxonomists, particularly in biodiversity-rich regions where businesses operate, this represents a "double extinction": losing both species and the expertise to describe them, leaving businesses unable to assess their true biodiversity dependencies and risks.

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