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The International eDNA Standardization Task Force (iESTF): toward development of inclusive international standards for eDNA biodiversity monitoring

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Abstract

Environmental DNA (eDNA) analysis has emerged as a transformative tool for biodiversity assessment and environmental monitoring, offering a non-invasive, cost-effective approach to detecting species and characterizing ecological communities. Despite growing adoption by researchers, regulatory agencies, and industry, the widespread implementation of eDNA methods continues to face challenges, including inconsistent protocols across laboratories and the absence of internationally recognized standards. These barriers have slowed the integration of eDNA into routine monitoring programs and other operational settings, particularly in regulatory contexts. Standardization is widely recognized as an essential prerequisite for building confidence among end

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users and enabling meaningful comparison of results across studies and jurisdictions. While standards development efforts have begun to emerge at national and regional scales, the lack of international coordination risks producing fragmented or contradictory guidelines that could hinder rather than advance the field. Here, we introduce the International eDNA Standardization Task Force (iESTF; https://iestf.global), an initiative established to facilitate and accelerate the development of inclusive international standards for eDNA-based biodiversity monitoring. The iESTF aims to identify opportunities for new work item proposals within the International Organization for Standardization (ISO) framework, catalog existing standards and best practices, and ensure that standards development is accessible to practitioners in nations historically underrepresented in eDNA research. We outline some key challenges facing eDNA standardization, describe the structure and goals of the iESTF, and present a vision that includes the formation of a truly inclusive international community of practice, the establishment of pipelines for fast-tracking the development of international standards, and support for critical activities such as cross-regional standards testing and validation. The iESTF represents a critical step toward ensuring that eDNA methods achieve their full potential as reliable, globally comparable tools for biodiversity monitoring.

Key words: Biodiversity, Ecological analysis, eDNA, Environmental assessment, Environmental DNA, Genomics, Metabarcoding, Standardization

Environmental DNA: finally ready for the spotlight?

In the last decade, analysis of environmental DNA (eDNA) has gained considerable momentum for biodiversity assessment and environmental monitoring. The breakthrough innovation is built on two main premises: (1) genetic material (DNA or RNA) contained in or shed by living organisms can be directly extracted from environmental samples such as water, soil, air, sediments, and various bulk biomass samples (e.g., Malaise traps and benthic kicknets); and (2) the taxonomic identification of those organisms can be accomplished using short, taxonomically informative, and often species-specific regions of the genome, i.e., DNA barcodes. These are the main criteria broadly used in the field for defining eDNA (Taberlet et al. 2012; Pawlowski et al. 2020a).

The use of eDNA has gained popularity because of the relative simplicity of generating eDNA data compared with traditional methods for assessing ecological status or species distributions. Researchers with access to molecular biology and genomics laboratories have used eDNA in various investigations, including general baseline biodiversity assessment (Lopez et al. 2025), functional ecological network studies (Cantera et al. 2025), and surveys of specific taxa such as invasive or endangered species (e.g., Sepulveda et al. 2023). In a relatively short time, a rapidly increasing number of studies have showcased the use of eDNA in ecological and environmental investigations (McGee et al. 2019).

In addition to the use of eDNA in research, various regulatory agencies, nongovernmental organizations (NGOs), philanthropies, and industrial sectors have been eager to adopt eDNA tools in their approaches, goals, and mandates. Given the importance of biodiversity and species identification in various policies, researchers in applied science and regulatory agencies have

been among the pioneers in eDNA applications. For example, government environmental agencies in countries such as Canada, the United States, and Japan, as well as in the European Union, have extensively researched the use of eDNA in their frameworks for monitoring target species, including endangered and invasive species and those of commercial value. The U.S. Fish and Wildlife Service employs eDNA to track invasive carp in the Great Lakes (Mize et al. 2019); Fisheries and Oceans Canada (DFO) uses eDNA methods for invasive species detection (Abbott et al. 2021); and the National Oceanic and Atmospheric Administration (NOAA) has applied eDNA for fish stock assessments (Baetscher et al. 2025). Similarly, NGOs such as the World Wildlife Fund (WWF) and The Nature Conservancy have been using eDNA to support conservation initiatives, particularly in monitoring species distributions in remote and inaccessible habitats (Lyet et al. 2021). Analysis of eDNA has also been transformative for industrial sectors, especially in energy, mining, agriculture, and infrastructure development, where companies need to assess the environmental impact of their activities. For instance, energy companies conducting offshore drilling operations have used eDNA to monitor marine biodiversity changes over time, ensuring compliance with environmental regulations (Mauffrey et al. 2021).

Hurdles to adoption of eDNA methods

Although eDNA methods have demonstrated value in a range of applications and shown promise in many areas, uptake has faced challenges. For example, physical confirmation of species detections is often problematic because eDNA methods have significantly higher sensitivity than other monitoring tools. Validation of eDNA results can be especially challenging in complex and large systems such as oceans or tropical forests, thus presenting a challenge to understanding false-positive and false-negative rates. Decision-makers understandably may be hesitant to rely on eDNA signals alone, given the political risks associated with acting in response to unconfirmed species detections (Lee et al. 2024). As such, work has been conducted specifically to support the translation of eDNA science into real-world applications (e.g., Aylagas et al. 2020; Abbott et al. 2021; Sepulveda et al. 2023).

Challenges related to the consistency of eDNA methods and outputs have also posed hurdles to adoption. For example, comparing results from the same eDNA sample analyzed in different laboratories (i.e., interlaboratory reproducibility; Zaiko et al. 2022) or eDNA data processed across different analytical pipelines can result in considerable variation depending on the pipeline or analyst (e.g., Jones et al. 2025; Vasselon et al. 2025). While generating eDNA data can be accomplished in most molecular laboratories and sequencing facilities, there is commonly a lack of sufficiently rigorous method design and validation, standardization of methods across facilities, and adequate quality control measures. Together, these can lead to data that are difficult to interpret or even unreliable, which in turn may create a lack of trust in the technology among resource managers and thwart adoption. Nevertheless, there has been significant work addressing the various hurdles that impede the use of eDNA methods for applications, which has resulted in more reliable eDNA methodologies, especially for single-species detections (Hunter et al. 2026).

Standardization is an essential pillar for adoption

There have been various calls for the establishment of quality assurance (QA) and quality control (QC) in the application of eDNA methods (e.g., Theroux et al. 2025), as well as outputs providing specific guidance or tools for increasing the quality and transparency of generated eDNA data (e.g., Klymus et al. 2020, 2024). In terms of formal standards (Theroux et al. 2025), there are two main types that, when applied together, ensure the consistency, reliability, and accuracy of environmental measurements. There are international standards for internal quality management systems (such as ISO 9001 and ISO/IEC 17025), which are important and directly applicable to the field of eDNA but rarely used (Lee et al. 2024), and there are methodological standards (e.g., ISO 17805:2026) that define requirements for specific technical procedures. For example, various national and regional initiatives have been working on frameworks to define best practices for eDNA sampling, analysis, and interpretation (see below). These standards reduce variability caused by differences in sample collection, laboratory procedures, and data reporting by establishing minimum requirements that are obligatory. This leaves laboratories the freedom to use various validated procedures (e.g., analytical pipelines and primers) while ensuring a minimum level of quality assurance.

The development of rigorous standardization procedures, including analysis of certified reference material, will enable stakeholders such as government agencies, conservation groups, and industry partners to confidently integrate eDNA data into decision-making while ensuring compliance with environmental policies and biodiversity conservation goals. While academic or conservation groups are less likely to require formal accreditation to an international standard, they can still choose to adopt it to increase the comparability and quality of results. Commercial or government providers often need external third-party verification to generate trust and transparency in their services. Thus, commercial or some government laboratories providing eDNA services are likely the main entities that will require accreditation to a standard to meet their needs, such that the additional costs of accreditation will be outweighed by the benefits for these sectors.

Standards for eDNA have started to emerge in the last 5 years at various scales. For example, the EU research network DNAqua-Net established a standardization working group as part of the European Standards Committee CEN, which aided in establishing a framework for validation of eDNA analyses (EN 17805). Other notable efforts include a United States–Norway collaboration on developing standards for marine eDNA analysis (United States – Norway Intergovernmental Group on eDNA Implementation for Fisheries Stock Assessments and Management 2020) and the Canadian Standards Association, which developed a standard for qPCR analysis of eDNA (Department of Fisheries and Oceans 2020). Additionally, a dedicated working group in ISO has adopted an approach to fast-track the conversion of the EN 17805 standard—a standard procedure for sampling eDNA in aquatic environments—to the ISO level (published in July 2026; see Box 1). In Australia, the Department of Agriculture, Fisheries and Forestry created the Australian National eDNA Reference Centre as a centralized authority with the responsibility of validating, maintaining, and optimizing assays and protocols

to provide high-quality standards for the application of eDNA technology (De Brauwer et al. 2023). However, industry groups continue to emphasize the lack of standards as a key hurdle to implementing eDNA-based tools in routine environmental assessment. For example, the International Oil and Gas Producers Association (IOGP) has independently formed a Joint Industry Programme on environmental genomics and commissioned four reports mainly focused on developing guidelines for the application of eDNA in oil and gas operations (eDNAtec and CEGA 2025a, 2025b; NatureMetrics and IDGene 2025; Stantec and NatureMetrics 2025).

Analysis of eDNA is a multistep process (Porter and Hajibabaei 2018), each step of which presents opportunities for guidelines and standards to avoid errors that can influence results (Fig. 1). The workflow begins with field sampling, where standardized protocols for site selection, metadata assessment and reporting, sampling volume, contamination prevention, and replication are essential—and sufficient experience exists to recommend minimum standards. These steps are followed by sample preservation and

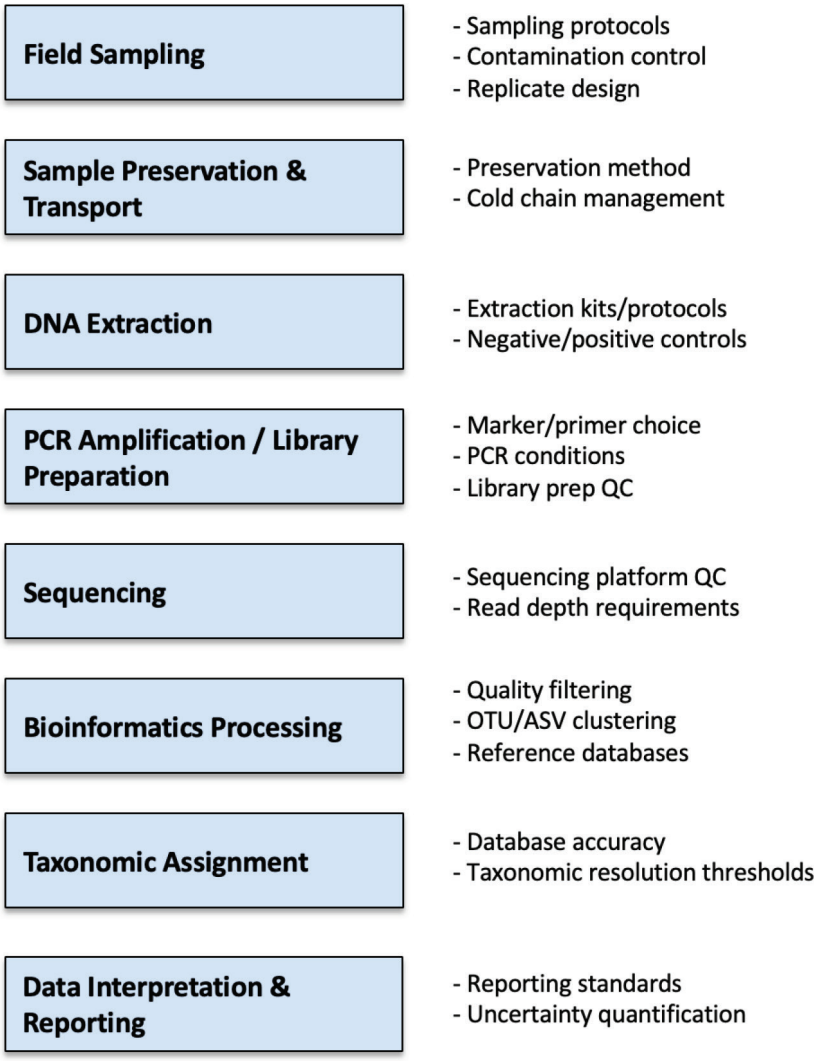


Figure 1. Workflow of eDNA analysis from sampling to reporting, highlighting key stages where standards are critical to ensure the accuracy, reproducibility, and comparability of results.

transport, where consistent preservation methods and temperature controls ensure DNA integrity. Extraction of DNA requires validated protocols and contamination controls to produce high-quality templates for downstream analysis. A variety of quality procedures and metrics are available for analysis of eDNA by quantitative PCR (Goldberg et al. 2016; Klymus et al. 2020). For analysis by sequencing, marker and primer selection, reaction conditions, and quality checks must follow standards to ensure comparability during PCR amplification or library preparation. Sequencing should also follow agreed-upon quality and quantity measures, including platform calibration and read-depth requirements. In bioinformatics processing, consistent filtering thresholds, clustering or denoising methods, and the use of curated reference databases are critical for reproducibility. Taxonomic assignment benefits from reference standards and clear resolution thresholds, while data interpretation and reporting require transparent frameworks for uncertainty estimation and standardized reporting formats. Without standards across all these stages, results may be inconsistent, hindering the reliability, comparability, and uptake of eDNA methods in research, monitoring, and policy applications.

Overcoming challenges to standards development requires international cooperation

Applications of DNA- and eDNA-based technology for biodiversity assessment and monitoring have progressed rapidly in the past decade, fueled by ongoing innovation in sequencing technology, autonomous sampling, and bioinformatic and statistical data analysis. At the same time, there has been an explosion of exemplar applications in almost every conceivable biodiversity monitoring context. The current moment is one for both optimism and caution: the future of eDNA biomonitoring is bright, but rapid progress presents two significant challenges that require international cooperation to realize the promise of eDNA.

In an environment of active methods development, how can we avoid the proliferation of potentially competing (or even contradictory) national, regional, or laboratory-specific standards?

Difficult lessons learned from the early adoption of eDNA methods (Lodge 2024) provide sufficient motivation to ensure that internal quality management of eDNA processes is now nearly universal. However, the slow uptake of eDNA tools in management, decision-making, and policy contexts has led to strong pressure to develop more formal standards with broader applicability. The response has been a proliferation of guidelines and best practices in a wide variety of contexts (Theroux et al. 2025). For instance, multiple national guidance documents for the development of eDNA protocols in aquatic ecosystems now exist in Canada (Abbott et al. 2021), Japan (Minamoto et al. 2021), Switzerland (Pawlowski et al. 2020b), Finland (Jerney et al. 2022), and Australia (De Brauwer et al. 2023). These documents exhibit varying degrees of overlap in both applicability and methodological detail. There are similar documents aimed at more specific regional needs or biological endpoints, all broadly seeking to improve

Table 1. Different eDNA-related procedures designated as published ISO standard, formal ISO projects, and candidate New Work Item Proposals (NWIPs).

Description	Leads (country)
ISO 17805:2026 Sampling, capture, and preservation of environmental DNA from water	M-T Werner (Germany), M Traugott (Austria)
ISO/NP 25806 Water quality—Guidance on field and laboratory procedures for aquatic macroinvertebrate sample preservation for DNA-based analyses	F Leese (Germany), M-T Werner (Germany)
ISO/NP 25807 Water quality—Guidance on laboratory procedures for mechanical homogenization and DNA extraction of aquatic macroinvertebrate samples	M-T Werner (Germany)
FprEN 13946:2025 Water quality—Guidance standard for the routine sampling and preparation of benthic diatoms from rivers and lakes	M Kelly (UK)
ISO/PWI 25605 Water quality—General principles for quality assurance of molecular biological examination for environmental DNA	S Heeman (Netherlands)
Extraction of aquatic environmental DNA (eDNA) from filters	C Abbott (Canada)
Target species detection (qPCR and dPCR for eDNA and eRNA)	K Klymus (USA)
Metabarcoding to survey biological communities	M Hajibabaei (Canada), DJ Baird (Canada)
DNA extraction for diatom metabarcoding	B Paix (France), F Rimet (France)

consistency in eDNA data generation and reporting. While these developments support more rigorous quality assurance and thus greater defensibility of eDNA tools, new practitioners, end users, and potential investors might see this abundance as an impediment rather than an invitation. International leadership will be required to catalog the diversity of standards that already exist, assess their alignment (or lack thereof), and encourage more collaborative approaches to the development of future international standards. We do not advocate a "one standard fits all" approach; seeking unity when it is operationally needed (e.g., for comparability) and advocating diversity when it is necessary (e.g., for feasibility and resource availability) should be a goal of the international eDNA community. As such, some standards may be more specific to a particular scenario, whereas others may cover a broader application window (Table 1).

How can we avoid the development of standards that limit rather than expand access to eDNA-based monitoring solutions?

Environmental DNA (eDNA) analysis holds great promise for global biodiversity monitoring, which is a key strength; new standards need to guard against overly strict laboratory requirements that risk excluding much of the world or creating technology lock-in. In many countries, especially across the Global South, laboratories face limited access to infrastructure such as high-throughput sequencers, reliable cold storage, or clean-room facilities (Hirsch et al. 2024). Similarly, the accessibility of eDNA methods to non-specialists presents enormous potential for the democratization of biodiversity monitoring through community-based science and the participation of marginalized groups (Kondoh et al. 2024), which is another driver for prioritizing inclusivity in the development of future standards. If international frameworks mandate excessively high methodological requirements, they may unintentionally create barriers to participation, reinforcing inequality and limiting the contribution of regions rich in biodiversity but

constrained in resources. To ensure inclusive and equitable global uptake while retaining rigor and quality, adequate laboratory best practices should be required, focusing on essential QA/QC elements such as contamination control, transparent documentation, and basic validation (Altermatt et al. 2025). This approach prioritizes data reliability while allowing diverse groups to participate, fostering capacity building, collaboration, and representation from all regions, and it has already begun to take shape in several large-scale monitoring initiatives. An example of this approach can be found in the ANEMONE network (All-Nippon eDNA Monitoring Network) and its international extension, ANEMONE Global (Kondoh et al. 2024; Sioud et al. 2026). These initiatives demonstrate how eDNA-based biodiversity monitoring can be scaled nationally and internationally by emphasizing minimum quality requirements, standardized metadata, and transparent protocols while avoiding excessive technical barriers. By design, ANEMONE and ANEMONE Global accommodate a wide range of participants—including academic institutions, local communities, and non-specialist contributors—thereby illustrating how inclusive, minimum-standard frameworks can generate comparable and policy-relevant biodiversity data across regions with highly diverse technical capacities. In turn, global monitoring efforts will be more comprehensive, fair, and scientifically robust. For example, in the ANEMONE Global initiative, harmonized protocols for filtration, preservation, metadata recording, internal standards, and contamination controls were used across 12 countries. At the same time, protocols were more flexible where local conditions affected feasibility, such as site selection based on local priorities, sampling logistics, available clean equipment, shipping constraints, and adjustments to filtered volume in turbid or clog-prone waters (Sioud et al. 2026).

The International eDNA Standardization Task Force is a catalyst to facilitate international standards development

Developing standards for technologies is typically an in-depth, costly, and time-consuming process. For example, establishing a standard within the Canadian Standards Association (CSA) framework can take up to 2 years and requires substantial funding. The International Organization for Standardization (ISO) standards development process takes typically 2 to 3 years (see Box 1 for details), and costs are covered by the organization (International Organization for Standardization 2026). The process involves a dedicated Working Group within an ISO Technical Committee that evaluates candidate standards and develops them for ISO adoption. Decisions on whether to accept draft ISO standards are made by member countries on the Technical Committee through voting and endorsement by ISO. This system is well established and effective; however, given the formal structure and protracted timelines for ISO standards development, it is essential that new work item proposals for new International Standards (or Technical Specifications) for rapidly emerging technologies be developed with expediency in mind. This can be accomplished by having some level of informal international agreement on potential new standards and their drafts prior to the formal ISO process.

Box 1. ISO standard development process (International Organization for Standardization 2026).

Proposal stage (New Work Item Proposal—NWIP)

A new standard proposal is submitted by a national standards body (NSB), an industry group, or a technical committee (TC). The proposal is reviewed and voted on by member countries within the relevant ISO TC, and if approved, the project moves forward to the next stage.

Timeline: Typically 2–6 months

Preparatory stage (Working Draft—WD)

A working group (WG) of experts is formed to draft the technical content of the standard. The draft is shared within the technical committee for discussion and refinement. Multiple iterations may occur before reaching consensus.

Timeline: 6–12 months

Committee stage (Committee Draft—CD)

The draft standard is shared with the full ISO technical committee for comments and revision. Technical refinements are made based on feedback. Consensus must be reached before proceeding.

Timeline: 3–6 months

Enquiry stage (Draft International Standard—DIS)

The draft is circulated for public consultation among ISO member countries. National standards bodies vote and provide feedback. If there is strong agreement (≥66% approval), the standard moves forward.

Timeline: 3–6 months

Approval stage (Final Draft International Standard—FDIS)

The final version of the standard is prepared, incorporating feedback from the DIS stage. A formal vote is conducted among participating member countries within the relevant ISO TC (requiring ≥ 75% approval). Once approved, the standard proceeds to publication.

Timeline: 2–4 months

Publication stage (International Standard—IS)

The standard is officially published as an ISO standard and made available for purchase and implementation. The standard is reviewed every 5 years for updates or revisions.

Timeline: 1–2 months

Timeline for ISO standard development: Typically 2–3 years from proposal to publication.

The International eDNA Standardization Task Force (iESTF; https://iestf.global) is a community formed to facilitate and accelerate the development of standards for eDNA analysis. The main motivation of iESTF is to achieve a step change in standards development for eDNA. iESTF engages eDNA researchers with experience developing eDNA guidelines or standards from various regions around the globe to work together on building consensus before nascent standards are proposed to standardization bodies (e.g., ISO) as potential New Work Item Proposals (NWIPs). Rather than waiting for regional and national eDNA standards to emerge across jurisdictions, iESTF aims to foster inclusive dialogue and coordination among regions and nations in a more informal and dynamic setting. The goal is for truly international precursors to ISO and other standards to be developed and presented to the relevant authoritative bodies, which may otherwise be out of reach due to a lack of national participation, coordination, or financial resources. Key to this process is encouraging representation from all groups that have critically important roles to play in the future of biodiversity discovery and monitoring, including representatives from the Global South and Indigenous communities.

The iESTF is intended to play several important roles in meeting the challenges outlined above. Its most immediate role is to identify opportunities for the

development of NWIPs for consideration by ISO. Some eDNA applications are more developed than others, and recognizing those that have achieved sufficient maturity to enable the establishment of international standards is the first step in fast-tracking the acceptance and broad dissemination of eDNA tools. This work has already begun; within iESTF, multiple task groups are compiling information and building consensus on candidate NWIPs. Several of these are now in the ISO standards development process (Table 1; also see Box 1). The task of developing NWIPs is typically initiated by suggestions from the iESTF community on workflows and methodologies suitable for standards development. An ad hoc committee from the iESTF membership is formed for each NWIP, with a lead and co-lead serving as coordinators. This committee carries out the task of assembling a draft NWIP through consensus building among committee members. The draft NWIP is presented to the iESTF co-chairs and subsequently to the iESTF members for review and comment. The final draft of an NWIP is presented to ISO working groups via members of iESTF who also serve as ISO delegates. All records are kept by committee chairs and subsequently transferred to the iESTF co-chairs for full transparency. iESTF aims to achieve consensus across sectors and regions, with particular attention to ensuring that proposed standards remain broadly applicable across different levels of technical capacity. Decisions are made in ways that preserve scientific independence, transparency, and conflict-of-interest management.

Similar to many other scientific and technological endeavors, eDNA technologies have been mainly researched and developed in nations with substantial resources devoted to scientific research and development. Analysis of available publications shows that hotspots of eDNA expertise are predominantly in Europe, North America, Australia, New Zealand, and Japan (Fig. 2). Although the core membership of iESTF currently includes participants from 11 nations within these hotspots, there is a clear need to engage researchers and users from other regions, especially in the Global South. The establishment of a truly representative international community of experts that brings diverse contributions and requirements to discussions on, and the drafting of, proposed ISO standards is vital to ensure that they will be both effective and accessible. Outreach beyond the traditional regional hotspots of eDNA expertise and the dominant sectors of academia and government is crucial to accomplishing iESTF's goals.

Also important to achieving iESTF's goals is an effort to catalog and assess existing standards, guidelines, and best practices for eDNA. This is important, first, to understand which eDNA applications have achieved a level of maturity and acceptability sufficient to be ready for formal international standards and, second, to establish a comprehensive library of available standards for practitioners, end users, and other interested stakeholders. Having these resources in a single, accessible catalog would be of substantial utility to the international eDNA community.

The iESTF goals are attainable but ambitious for a young, grassroots effort not directly supported by any existing institution or funding body. iESTF currently comprises entirely volunteer positions with minimal structure; however, brief Charter have been developed to ensure objective criteria for conducting the work (Appendix 1). The co-chairs have generally been responsible for inviting experts from different regions and sectors to establish the initial membership as a diverse group of eDNA scientists. Further expansion will require more collaborative and deliberate outreach efforts.

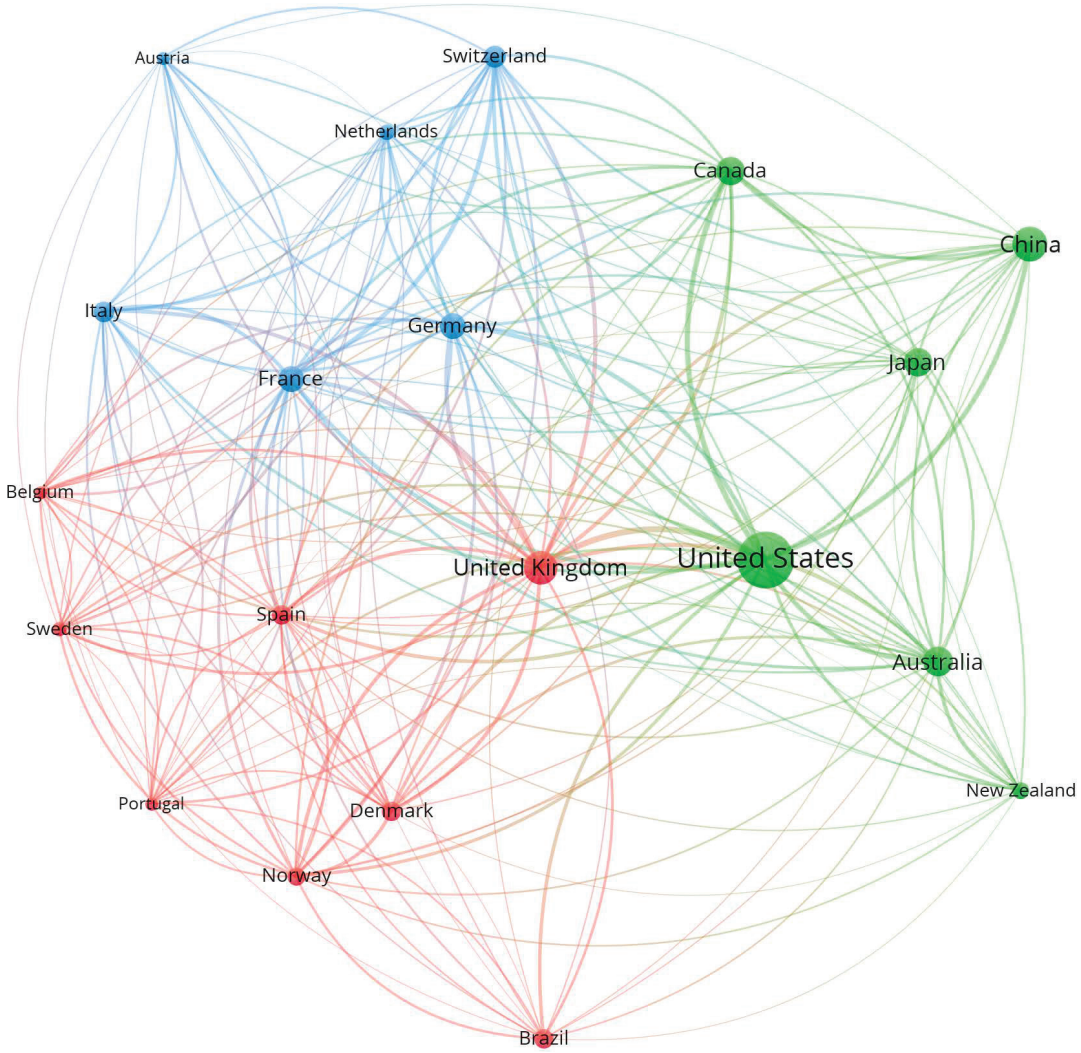


Figure 2. Global eDNA research network based on the available literature (11,028 publications, accessed on 30 January 2026). Each country is represented by a circle proportional to the number of papers published. The top 20 countries are shown in the figure for visual clarity. Lines represent links between countries based on co-published papers; colors represent clusters based on higher levels of collaboration.

A vision for the future

As early contributors to this international effort, we also recognize the potential need for growth beyond these modest, informal beginnings. As eDNA methods enter broader use in management, decision-making, and policy, the international community of practitioners and users will require resources that are unlikely to be provided by existing institutions. The aforementioned library of standards, guidelines, and best practices is one example, and in that context, it is worth noting that formal standards are generally not free. This is because their development, review, and maintenance require sustained expert work and global consensus-building, and charging for access ensures the sustainability of this system. It is, however, important to note that both the standards development process and ISO itself operate on a not-for-profit basis. The inclusive vision of iESTF is that, as the catalog of existing standards grows, financial support for users without the resources to access them independently may be essential.

Another vital prerequisite for the development and maintenance of future standards is the availability of standardized reference material (SRM). There are currently no publicly available SRMs for non-microbial endpoints (Theroux et al. 2025), despite the value of these materials for proficiency testing and potential accreditation (Trujillo-González et al. 2021), suggesting that there is little existing motivation or insufficient resources to generate, maintain, and disseminate them. Identification of appropriate resources and establishment of mechanisms to support such work could have a catalytic effect and ultimately result in a considerable return on investment for the eDNA community.

Another area of need unlikely to be met by existing institutions is the testing of proposed standardized methods outside the geographic contexts in which they were developed. While an international group of experts can provide feedback on proposed standards and note novel challenging conditions that may arise in other regions, there is no substitute for on-the-ground testing of standard methods. Given existing dynamics, it is most likely that standards developed in the current hotspots of eDNA expertise would require testing in regions outside those hotspots, predominantly in the Global South. Small grant programs designed to support such testing would both provide realistic assessments of the global utility of proposed standards and create opportunities for new practitioners to engage in the process and potentially establish monitoring efforts in their regions. In this case, iESTF can play a key role in providing the expertise and structure to aid the independent development of these efforts.

Beyond the direct provision of such resources to the eDNA community, iESTF should also support eDNA methods in multiple international contexts, including the incorporation of eDNA into broad regional and international biomonitoring initiatives, the formal recognition of eDNA in future policy frameworks governing biodiversity protection, and the establishment and support of internationally accepted ethical guidelines for the collection and use of eDNA data. The latter is particularly apt, given that such considerations have been an abiding concern of the standardization community (Theroux et al. 2025) and that the ideally constituted membership of iESTF should be well positioned to address ethical issues such as data sovereignty (Hirsch et al. 2024) and the incorporation of FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) principles (Carroll et al. 2021).

This expanded vision of the role of iESTF will require considerable growth in the coming years, including substantial broadening of the membership and appropriate funding sources to support more resource-intensive initiatives. Nonetheless, the time for these actions is now. eDNA methods are increasingly overcoming the technical challenges that previously limited them (Baetscher et al. 2025), and the development of standards is the logical next step to support their broader adoption for applications. The goal of iESTF is to deliver on the future promise of eDNA tools by ensuring that international eDNA standards are as broadly applicable, accessible, and useful as possible.

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Appendix 1

Charter

of the

International eDNA Standardization Task Force

1 February 2026

1. **Official designation.** International eDNA Standardization Task Force, or iESTF.
2. **Authority and reporting.** The iESTF is an independent organization and does not operate under the auspices or authority of any government, academic, or industry body, nor is it directly affiliated with any organization, including those with which individual iESTF members claim affiliation. Its reporting responsibilities are solely to its members, the environmental nucleic acids research community, and potential end users of environmental nucleic acid methods.
3. **Objectives and scope of activity.** The iESTF exists to advance the development, formalization, and dissemination of standards for the application of environmental nucleic acid (eNA, including eDNA and eRNA) analysis for environmental monitoring and biodiversity assessment. The iESTF leverages resources and knowledge from members of the eNA community for the coordinated and timely adoption of international standards and to make those standards accessible to all potential end users; it engages with the eNA research community to help set minimum quality requirements for standardized procedures while allowing room for growth and optimization; it develops relationships with stakeholders, including policymakers, managers, and various industry user groups; it works with various working groups of the International Organization for Standardization (ISO) for the effective development of standards for a variety of applications; additionally, it provides a point of contact for information, resources, and educational material relating to eNA standardization.
4. **Financial support and operating costs.** The iESTF has no annual budget and no standing income. Financial support to cover expenses for iESTF operations will be solicited from external organizations on an ad hoc, not-for-profit

basis. Funding for such operations will be obtained in a manner that is free from conflicts of interest involving either iESTF members or their associated institutions. Funding sources will not have any influence on iESTF decisions.

5. **Membership.** iESTF membership comprises eNA professionals with expertise and experience relevant to the development, formalization, and dissemination of standards for eNA applications in any field of environmental monitoring or biodiversity assessment. The iESTF encourages membership by practitioners from groups historically underrepresented in eNA science, including the Global South, Indigenous communities, and developing nations. Requirements of membership include regular participation in iESTF activities and adherence to the ethics guidelines specified below. New members are initially proposed by any existing iESTF member and are thereafter confirmed by a unanimous vote of the Steering Committee. Membership proposals, expressions of interest, and nominations can be made by any interested party to any existing member of the iESTF; there is no formal application process for new members. There are no term limits for iESTF members.
6. **Meetings.** Meetings of the entire iESTF will be conducted on an ad hoc basis, as determined by the Co-Chairs of the Steering Committee. Meetings are run by the iESTF Chair or a designee identified by the Chair prior to the meeting. The Chair or the Chair's designee shall provide an agenda for the meeting at least 1 business day prior. Meetings will be conducted by video using a platform agreed upon by the iESTF membership. In-person meetings of the iESTF will also be held on an ad hoc basis, with the location, timing, and agenda of these meetings being determined by the Steering Committee with input from the entire iESTF membership.
7. **Steering Committee.** The iESTF Steering Committee (SC) exists to provide general guidance to the iESTF, enforce ethics rules, establish ad hoc committees, and lead and organize special efforts of the iESTF as needed and as specified below.
    a. **Membership and term limits.** All positions on the SC will be filled voluntarily, with terms of service expected to last 2 years and incumbency limited to three consecutive terms, for a maximum of 6 years. Any iESTF member can volunteer for a seat on the Steering Committee. SC positions that are open either due to term limits or resignation of the incumbent shall be filled by any current member of the iESTF, with election confirmed by a unanimous vote of the existing SC. The SC shall consist of no fewer than 10 and no more than 15 iESTF members.
    b. **Specific roles and responsibilities.**
        i. **Chair.** The Chair is responsible for calling and running meetings of both the SC and the iESTF. The Chair shall set and distribute the agenda for those meetings, maintain order, and determine future action items. The Chair is also principally responsible for identifying the financial needs of the iESTF and ensuring that those needs are met through solicitation of support from external organizations.
        ii. **Co-Chairs (3).** The Co-Chairs assist the Chair in the above responsibilities. In the event that the Chair is unable to serve in one of their assigned capacities (e.g., running a called meeting), one of the serving Co-Chairs will be selected to temporarily replace the Chair. Together with the Chair, the Co-Chairs are responsible for

setting the overall agenda for the iESTF, identifying iESTF goals and setting appropriate deadlines, assembling necessary expertise from among the membership to accomplish those goals, and communicating iESTF accomplishments to important partners and the broader eNA community.

iii. **Secretary.** The Secretary is charged with taking and archiving minutes of all SC and iESTF meetings and distributing brief meeting summaries to the iESTF membership. The Secretary is also responsible for maintaining an accurate roll of all active iESTF members and their contact information.

iv. **Communications coordinator.** The Communications Coordinator will be responsible for maintaining outreach materials, including the iESTF website, and for advertising iESTF activities open to outside participants.

v. **Elections and term limits.** Individuals serving in all of the roles described above will be elected by the SC from among the SC membership for a minimum 2-year period, which can be renewed twice for a maximum incumbency of 6 years. Election to positions and subsequent renewals will be determined by unanimous vote of the SC.

c. **Meetings.** The SC will meet at least quarterly, with the timing and agenda of meetings determined by the Chair. Meetings will be conducted by video using a platform agreed upon by the SC. In-person meetings of the SC may also be held on an ad hoc basis, with the location, timing, and agenda of these meetings being determined by the SC. Meetings will be run by either the Chair or a designated Co-Chair, based on an agenda distributed at least 1 business day prior. Formal decisions by the SC, including decisions on membership and the timing and content of general meetings, will be made at these meetings. Such decisions will be made by the entire SC; in the case of absences, input will be solicited via email or other communication. Other informal decisions of the SC may be made either at SC meetings or externally via communication among SC members.

8. **Working groups.** Proposals for Working Groups may be made by any member of the iESTF, and the establishment of Working Groups will be determined by a simple majority vote of the SC. Establishment of a Working Group entails assignment of a Working Group Lead, solicitation of contributors, and specification of Terms of Reference for the Working Group, including determination of specific deliverables and a time frame for delivery.

9. **Ethics guidelines for members.** All iESTF members are expected to display collegial conduct, be respectful and inclusive, debate ideas and not individuals, uphold standards of academic and scientific integrity, and abstain from any form of harassment or discriminatory behavior. iESTF members are expected to avoid any real or perceived conflicts of interest in their work for the iESTF. Members appointed to the iESTF in their official capacity as government employees are subject to ethics statutes and regulations established by those governments, including applicable exceptions and exemptions. Nongovernmental members are expected to recuse themselves from any iESTF or subcommittee deliberations or votes relating to a specific matter in which the member, or the entity the member represents, has a direct financial interest. Any member found to be in violation of the above guidelines may be removed or placed on probation by unanimous vote of the SC.

10. **Duration and termination.** The iESTF will continue until its termination is decided upon by a unanimous vote of the full SC, followed by a simple majority vote of the general iESTF membership.
11. **Changes to the Charter.** Every 3 years following the establishment of this Charter, the SC will hold a meeting expressly to review the Charter and will make a proposal for necessary changes to be considered by the iESTF at large. Ad hoc changes to this Charter will be enacted only after a unanimous vote of the SC, followed by a simple majority vote of the general iESTF membership.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Artificial Intelligence (AI) use

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Data availability

No new data were generated or analyzed for this article. Data used in Fig. 2 were retrieved on January 30 2026 by VOSviewer from OpenAlex database.