



GenomeCanada

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MEETING REPORT

Biodiversity Monitoring in Canada: Coordinating Genomics Methods and Data Across Initiatives in Canada and Worldwide— A Call for Action

*(Based on a Canadian Genomics Enterprise
working session at GEO BON 2023)*



INTRODUCTION

On Oct. 12, 2023, biodiversity experts from academia, government and non-profit groups were invited to a closed working session during the [GEO BON Global Conference: Monitoring Biodiversity for Action](#), which took place in Montreal, Quebec on Oct. 10-13, 2023.

Genome Canada and the six regional Genome Centres (the Canadian Genomics Enterprise) sponsored this discussion with several objectives in mind.

- To attract nationally and internationally renowned experts and create a unique opportunity to gather the community and encourage an exchange of ideas that is otherwise difficult to coordinate.
- To support structured discussions across the Canadian Genomics Enterprise and all contributors present to gain a better understanding of the challenges and opportunities currently faced by the biodiversity monitoring community.
- To ensure a unique setting, timing and context of the closed session so as to encourage participants to foster new relationships and leave the event with a strengthened sense of possibility and opportunities to act.

The GEO BON Global Conference came as a timely reminder of the Global Biodiversity Framework that was adopted during the [December 2022 United Nations Biodiversity Conference](#) (COP15). The ambitious and necessary objectives set in place by the framework will require a coordinated effort from scientists, community leaders, government, and industry, all of whom were present at the GEO BON Global Conference. Throughout the four-day event, several talks, workshops and panels were held to showcase innovative research and tools for the surveillance of biodiversity, but also to share insights from collaborative strategies across the globe.

As key members of Canada’s research community and thanks to a vast network that spans several sectors, the Canadian Genomics Enterprise is uniquely positioned to help coordinate

ABOUT US

[Genome Canada](#) is an independent, federally funded not-for-profit organization and a national leader for Canada’s genomics ecosystem. Working in partnership, and across sectors, we invest in, and coordinate genomics research, innovation, data and talent to generate solutions to today’s biggest challenges.

Genome Canada works closely with the Canadian government to address federal priorities for genomics. We also coordinate with a [pan-Canadian network of Genome Centres](#), which enables us to reflect regional and provincial priorities. This network is key to our impact, facilitating regionally focused programs, proactive business development and strong industry connections across the country.



and accelerate biodiversity monitoring in Canada. Each regional Genome Centre has direct connection to, and local knowledge of, the challenges faced and opportunities available at the provincial or regional level. They also have connections to decision-makers within their respective provincial government departments who have interests in biodiversity monitoring.

Together with Genome Canada's federal and international leadership, the six Canadian Genome Centres have a proven track record of leveraging federal investment to develop and deliver regional, national and international partnerships in a variety of sectors of social, environmental and economic importance. Moreover, the future of biodiversity monitoring increasingly involves the generation, analysis, storage and sharing of data—an area of focus and leadership for the Canadian Genomics Enterprise for over 20 years. Our long history of investing in the development and application of research towards understanding the economic, environmental, ethical, legal and social implications of genomics research and technology (GE³LS) has enabled novel pathways to the implementation of knowledge and realization of value created from research dollars. Finally, the Canadian Genomics Enterprise has been at the forefront of supporting the development of enabling technologies and infrastructure across all sectors that can be leveraged and directly applied to the activities of biodiversity monitoring.

As was described in Genome Canada's [Submission from the Canadian Genomics Enterprise to Environment and Climate Change Canada's 2030 Biodiversity Strategy Consultation](#), genomics will be an invaluable tool in the precise monitoring of biodiversity. The combination of earth observations and genomics was highlighted as essential for the future of biodiversity monitoring, and several outstanding Canadian projects^{1,2,3} are already underway to develop the tools and resources necessary for a successful strategy.

During the Canadian Genomics Enterprise-sponsored working session entitled "Biodiversity Monitoring in Canada: Coordinating Genomics Methods and Data Across Initiatives in Canada and Worldwide—A Call for Action", participants were invited to share their insights on four key topics surrounding biodiversity monitoring:

- Stakeholder and rightsholder engagement
- Standardizing tools for biodiversity monitoring
- Data management, integration and access
- Coordinating approaches across Canada

The group of 50+ participants was divided into smaller groups and discussed each topic in turn. This document serves as a summary of the main conclusions for each topic and as a call to action for the Canadian biodiversity community.

¹ [BIOSCAN Canada – Illuminating Canadian biodiversity](#)

² [Earth BioGenome Project](#)

³ [iTrackDNA](#)



DISCUSSION #1: STAKEHOLDER AND RIGHTSHOLDER ENGAGEMENT

- Stakeholders, rightsholders and partners come in a variety of forms. We need to create time and space to meet them, listen to them and build strong and bilateral relationships with them.
- They have interest, needs, challenges and knowledge that should be addressed at the very beginning of the process, in a co-creation approach. We need reciprocity, humility and trust. We also need to be transparent about tool limitations.
- We need to share a mutual understanding of the role, the needs, the expected outcomes and the results of a project.
- We mustn't underestimate the impact that knowledge and data might have on a business, community or group activities, as it may not always be positive. Discussing data governance and ownership among the project helps to support stake/rightsholder engagement.
- Education is a big part of stake/rightsholder engagement and must be presented in a way that target audiences (such as the general public or children) can understand the need for biodiversity monitoring and protection.
- Citizen science and stake/rightsholder engagement in data collection are critical drivers of innovation uptake.

DISCUSSION #2: STANDARDIZING TOOLS FOR BIODIVERSITY MONITORING

- We need a minimum standard that is accessible and equitable, especially for the Global South. Setting a "perfect" standard that may be inaccessible or unrealistic will only worsen the lack of biodiversity data in many southern parts of the world.
- Don't let the perfect be the enemy of the good.
- We should recognize that academic research doesn't require the same stringent standards required to inform policy and enable ecosystem management. Nonetheless, standardizing does mean documenting everything properly and following clear guidelines, especially when it comes to sequencing data (number of reads, metadata, etc.).
- Standards enable the ability to compare across datasets, across programs, countries, regions, etc. Often, there is no requirement to provide metadata until the end of a project, by which time funding has elapsed. Considerations for standards and documentation should be accounted and planned for from the initiation of a research project.
- Standards and good reporting make data trustworthy; an agreed-upon minimum ensures trust in the scientific process.



- Not all research groups need to adhere to strict standards (e.g., ISO 9001), but all can benefit from regular proficiency testing to ensure that data is trustworthy and reproducible.

DISCUSSION #3: DATA MANAGEMENT, INTEGRATION AND ACCESS

- Before integration, there is a foundational problem with the lack of a proper omics data infrastructure in Canada. An ideal infrastructure would:
 - Live beyond a single project and shouldn't belong to or have to be maintained by researchers as it comes at significant cost. There needs to be a long-term vision with continuous funding, which also separates the cost of generating data from maintaining storage.
 - Standardize submissions, terminology, metadata, infrastructure, etc.
 - Be freely accessible, remembering that there is also a need to redefine access and what will happen to the data once it is downloaded (usage, tracking, compensation, etc.). Also, access for communities needs to be considered (interface, ownership, rights, EDI), and the terms of data sharing need to be negotiated in advance.
 - Consider contracts and agreements for multiple layers of a database: liability, through to sharing and insurance, hosting, etc.
- There are also many areas for future discussion, such as whether raw data should be uncoupled from metadata or provenance of samples, whether samples are identified or de-identified and whether a database is centralized or decentralized.
- There should also be a vehicle for the storage of "lost data", or data that is not compatible but should still be preserved. This could be averted in the future by creating an app or electronic lab notebook to streamline the data upload process and ensure notes/comments can be categorized (for example, with drop-down menu buckets).

DISCUSSION #4: COORDINATING APPROACHES ACROSS CANADA

- Communication will be essential, either through a shared platform or portal or marketplace to exchange knowledge, ideas, data, access to expertise and to facilitate the idea of coordinated funding opportunities. This will also require reflection on how to ensure engagement with the platform; once participants or users are signed up, how do we keep them coming back to create future value?
- It is unclear which group has the mandate or legitimacy for such convening and communication activities. Multiple federal departments are engaged in different areas, both overlapping and non-overlapping.

- There is a need for trust to remove barriers to the use of genomics-based techniques by appropriately convincing users that tools and data are reliable. Having people interact in person is an important way to foster confidence and connectivity between those who generate data and those who use it. This will also require that researchers become better at communicating the value of the work in a way that non-experts can relate to and care about.
- To organize a coordinated approach, there must be a clear shared objective for others to align their activities around. At the same time, we must be careful to avoid unintentional in/out divisions with any coordinating effort, while respecting that effective action requires committed individuals rather than an all-inclusive approach.
- It is critical that no voice is ignored when considering a coordinated approach. Indigenous voices must be included and considered, and we must ensure the inclusion of Indigenous leadership and proper reporting to local communities.

CONCLUSION AND ACTION ITEMS

Several main themes emerged from the event's discussions. First, the importance of trust, whether it pertains to trust in data through standardized methods or proper documentation, or trust between partners when working with industry, government or communities. In all cases, transparency and honesty go a long way in ensuring that all parties are respected and can move forward confidently in a shared endeavour.

Another recurring sentiment in several discussions was the importance of finding a "good enough" solution to many of the present challenges and being careful not to be distracted by the search for a perfect option, as it likely does not exist.

Finally, the participants were asked who (government, industry, academia, non-profit, etc.) should be spearheading some of the necessary efforts identified, such as establishing a proper data infrastructure for omics data, developing basic and accessible standards, or coordinating the various efforts currently underway. In each case, the conclusion is that there is no clear champion for addressing these challenges, and no one is likely to be given the mandate of finding or developing the necessary solutions. It will be up to members of the biodiversity community, with appropriate supports, to come together to develop solutions for the benefit of all.

Specific principles and objectives were identified during the discussions, including the need to:

- Invest significantly in a foundational omics data infrastructure solution for Canada which is standardized at multiple levels.
- Ensure results are transparent, reproducible and comparable by having researchers engaging in new or existing research projects consider data generation, management and access at the earliest possible stage.



- Engage with stake/rightsholders as early as possible in the research process.
- Align our national data collection, storage and sharing standards and processes with international efforts.

Through structured roundtable sessions and a follow-up discussion and summary session, some of those principles and objectives merged to generate specific recommendations for the broader Canadian biodiversity monitoring community, including:

- Create a shared platform or portal for members of the Canadian biodiversity landscape to come together and coordinate their efforts.
- Coordinate with organizations such as the Digital Research Alliance of Canada to leverage existing public investments in computing infrastructure, services and capabilities.
- Formalize a community of groups and individuals with interests in biodiversity monitoring. The community should convene researchers from across academia, industry and government to facilitate coordination of activities and communication of results.

Attendees felt that two recommendations were well-suited to the strengths of the Canadian Genomics Enterprise model:

- Fund a large-scale challenge to support the development and implementation of DNA-based environmental and biodiversity monitoring solutions that materially improve our ecosystem management capabilities and support biodiversity retention, ecosystem health and invasive species control.
- Convene the fragmented biodiversity monitoring community to support the establishment of a coordinated community. We should secure the commitment of a 'coalition of the willing' that will work together to develop:
 - A white paper to outline a framework that guides the community's strategic planning and, ultimately, a roadmap towards research coordination.
 - A coordinated approach to funding research in biodiversity monitoring and ecosystem management.
 - Shared community values, principles, goals and objectives for Canadian biodiversity monitoring research, innovation and implementation.
 - Shared standards, principles and processes that align with the international community.
 - Connections to international research, development, implementation, and funding efforts.

The insights, requests and recommendations gathered from this workshop have increased the Canadian Genomics Enterprise's understanding of key challenges facing the use of genomics in the biodiversity monitoring space. They have helped us identify gaps where targeted funding with focused convening and coordination efforts should better position



Canadian researchers and conservationists to realize long-term benefits and impact from their work.

This new knowledge will be vital to help shape and inform future programming targeted towards biodiversity monitoring. Monitoring research and the inventions it enables will be a critical part of future biodiversity conservation and ecosystem management and engineering. Many contributors at the GEO BON Global Conference expressed the belief that the Canadian Genomics Enterprise has an opportunity to be a leader in the national efforts to protect and monitor biodiversity—and, by extension, support our national leadership on the world stage.

The time to act is *now*.



APPENDIX: PANEL SUMMARY

Genomic Translation: Adoption and Use of Genomic Tools and Technologies to Monitor Biodiversity

YouTube video link: <https://www.youtube.com/watch?v=2r27KcfFkgA>

Oct. 12, 2023, 10:15 am

GEO BON Global Conference

Montréal, Québec

Projects

During the G enome Qu ebec-hosted panel, three research projects funded in part by the Canadian Genomics Enterprise were highlighted and presented by a lead researcher from the project, accompanied by one of their end users. All of the featured projects involved the use of environmental DNA (eDNA) to detect, monitor and study different species.

[iTrackDNA: Non-destructive precision genomics for environmental impact tracking in a global climate change era](#)

was presented by Val erie Langlois and Jean-Christophe Guay. The project is working in collaboration with the Canadian Standards Association to establish the very first standards for the sampling, processing and analysis of eDNA to monitor biodiversity. With a variety of end users, they are developing targeted assays to detect and monitor species of interest in a non-invasive and precise method.

[Genomics to manage and protect caribou populations](#) was presented by Claude Robert and Jo elle Taillon. This project has developed a genomics-based assay to monitor caribou. The non-invasive technology allows ministries and monitoring agencies to accurately assign individuals to their respective population, determine the genetic diversity within the population and study changes in groups over space and time.

[Optimizing the eDNA approach to monitor biodiversity in Canada's marine protected areas](#)

was presented by Jennifer Sunday and Cathryn Abbot. Current efforts to monitor marine protected areas are struggling to accurately survey areas of various sizes, accessibility and of increasing quantity. To fill these gaps and ensure monitoring agencies have access to reliable methods, this project is developing a decision tool that determines how much sampling is required under different conditions to obtain actionable results.

Discussion

Researchers and end users discussed the success factors in establishing successful collaboration and the barriers to the adoption of new genomics tools. Taking the time to have meaningful and human interactions was critical to ensuring that needs on both ends were met.

Researchers also mentioned the importance of involving end users early in planning new projects. This is to ensure that what researchers perceive to be a potentially useful tool



actually serves its target community. Understanding the needs of the users also facilitates the adoption of new methods.

Because the field of genomics is rapidly evolving, it is critical to ensure inclusive and regular knowledge transfer between researchers and users. Many users aren't specialists and will need adequate training to implement genomics-based tools. This includes clear communication on the limitations of new tools and a proper understanding of what can or cannot be interpreted from eventual results.

Finally, using standardized approaches is essential to ensuring that results can be compared across space and time, and between research groups. Planning for appropriate data storage and management should also be considered early in the project.

Panelists

Valérie Langlois (Full Professor, Eau Terre Environnement Research Centre, INRS)

Jennifer Sunday (Assistant Professor, Department of Biology, McGill)

Jean-Christophe Guay (Environmental Advisor, Hydro-Québec)

Claude Robert (Full Professor, Université Laval)

Joëlle Taillon (General Director of Wildlife and Habitat Management, MELCCFP)

Cathryn Abbott (Research Scientist, Fisheries and Oceans Canada)



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