**A Portable DNA Species Detection Device for Conservation — Final Public Report to Alberta Innovates**

| | |
|---|---|
| **Alberta Innovates Project Number:** | G2020000261 |
| **Submission Date:** | December 8. 2025 |
| **Project Title:** | A Portable DNA Species Detection Device for Conservation |
| **Project Dates:** | Project Start: 1/7/2020 - Project End: 1/9/2025 |
| **Program/Call:** | Land and Biodiversity Program |
| **Final Report Prepared for:** | Alberta Innovates |
| **Final Report Prepared by:** | Carlos Filipe and Natalie Schmitt.<br>McMaster University McMaster University |


### Acknowledgements

This project was made possible through funding from Alberta Innovates (Clean Resources Program), with co-support from the Natural Sciences and Engineering Research Council of Canada (NSERC) and Canada's Oil Sands Innovation Alliance (COSIA). The work was led by McMaster University (Principal Investigator: Dr. Carlos Filipe), with Dr. Natalie Schmitt leading technology development, field validation, and knowledge mobilization through WildTechDNA. We extend our gratitude to partners in government, industry, academia, NGOs, and Indigenous communities who contributed expertise, samples, and field logistics.

**Disclaimer**

*Alberta Innovates (AI) and His Majesty the King in right of Alberta make no warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in this publication, nor that use thereof infringe on privately owned rights. The views and opinions of the author expressed herein do not necessarily reflect those of AI or His Majesty the King in right of Alberta. The directors, officers, employees, agents and consultants of AI and the Government of Alberta are exempted, excluded and absolved from all liability for damage or injury, howsoever caused, to any person in connection with or arising out of the use by that person for any purpose of this publication or its contents.*

## Table of Contents

# Executive Summary

Over the past five years, this project has advanced the development of a portable, affordable DNA detection device for wildlife conservation, capable of providing results in under twenty minutes without the need for laboratory infrastructure. Designed for use by non-specialists, the platform enables real-time, in-field detection of species of conservation concern. Using caribou as a proof-of-concept, the team achieved 100% inclusivity and over 98% specificity, with clear, binary results displayed on a lateral-flow strip similar to a rapid COVID-19 test.

The journey was far from straightforward. The COVID-19 pandemic caused nearly two years of disruption to laboratory work, delaying progress and forcing the team to innovate under challenging conditions. When work resumed, new chemistries, workflows, and hardware designs were developed through rigorous iteration and field testing—including under sub-zero conditions in northern British Columbia. Feedback from Environment and Climate Change Canada (ECCC) pilots revealed that while the first prototype produced no false negatives, a small percentage of false positives required laboratory confirmation.These findings informed subsequent engineering, which incorporated dried reagents to eliminate evaporation and enhance reliability, together with a simplified three-step workflow to support ease of use in remote settings.

The technology has since generated strong national and international interest. Highlights include a federal enforcement pilot with ECCC targeting illegal trade in European eels (*Anguilla* spp.); early discussions with the Province of British Columbia and the Northern Boreal Caribou Knowledge Consortium (NBCKC) to explore caribou and culturally significant species monitoring; collaboration with the Global Snow Leopard and Ecosystem Protection Program (GSLEP) on non-invasive snow leopard detection; and a partnership with Chuo University in Japan to validate assays for seafood provenance. A pilot with The Nature Conservancy (TNC) is in planning to assess the technology for environmental DNA (eDNA) and invasive species detection.

The project also received international recognition—including presentations at the CITES (Convention on International Trade in Endangered Species) Standing Committee and the GSLEP Ministerial Steering Committee, and honours through the Explorers Club EC50 and Canada's Clean50 Awards.

Over $1 million in independent funding has been invested by the project team to advance both the platform and a complementary AI-driven primer design tool that reduces DNA assay design time from months to minutes. Together, these innovations have positioned Canada as a leader in rapid, field-based conservation biotechnology, amplifying the original investments by COSIA (Canada's Oil Sands Innovation Alliance) and Alberta Innovates and demonstrating how Alberta-led research can drive global impact in biodiversity monitoring, enforcement, and sustainability science.

---

# 1. Introduction

Across Alberta and globally, biodiversity monitoring is constrained by the need for fast, affordable, and accurate tools that can identify species in the field. Conventional laboratory methods are slow, expensive, and dependent on specialized infrastructure, making them unsuitable for remote or time-sensitive applications such as species-at-risk surveys, industrial reclamation, and Indigenous Guardian programs.

This project addressed those gaps by developing a field-ready DNA testing platform that delivers clear species-level results in under twenty minutes. The test was designed to function like a lateral-flow pregnancy or COVID-19 test, bringing molecular precision to the field. Through Alberta Innovates support, the project demonstrated how innovation at the intersection of biotechnology, conservation, and engineering can empower communities and industry alike.

---

# 2. Project Overview and Evolution Across Milestones

## Milestone 1: Foundational Chemistry and Proof of Concept

The project began with the development of a robust, paper-based DNA extraction method compatible with degraded material such as feces. The first prototype integrated a simple amplification reaction with a lateral-flow readout for visual detection. Using archived caribou samples, the team proved the concept worked outside traditional laboratory conditions. Although the pandemic caused delays and restricted lab access, these constraints spurred new innovations, including early testing of dried reagents that could remain stable for months at ambient temperature.

## Milestone 2: Integration, Refinement, and Validation

With lab access restored, the team refined the chemistry, achieving consistent, rapid amplification and high specificity. Caribou-specific primers were designed and validated with the McMaster Ancient DNA Centre, and early prototypes were assembled. This phase established the groundwork for future field applications, with performance metrics set at under twenty minutes per test, 100% inclusivity, and over 98% specificity. The team also began exploring multiplexing—testing for multiple species simultaneously on one strip—and integrated genetic sex determination.

## Milestone 3: Field Trials and AI-Driven Expansion

The technology entered real-world testing. Field validation took place at the Toronto Zoo and later in northern British Columbia in partnership with the BC Caribou Recovery Program and Fort Nelson First Nation. Parallel to this, the AI-powered primer-design tool was completed, reducing assay design time from months to minutes and allowing the platform to be adapted for any species—animals, plants, or pathogens. This marked a critical step toward scalability and commercial readiness.

---

# 3. Methodology (Non-Confidential)

Due to the ongoing patenting process, specific technical details cannot be disclosed. At a conceptual level, the platform integrates three stages:

1. **Sample Preparation:** optimized for fecal and tissue samples, including degraded material.
2. **DNA Amplification:** proprietary, field-compatible chemistry engineered for speed, specificity, and tolerance to inhibitors.
3. **Detection:** lateral-flow strip visualization, producing intuitive results in under twenty minutes.

Early versions of the platform used liquid reagents. Subsequent engineering incorporated dried reagents to improve stability and field reliability. The dried-reagent platform has subsequently demonstrated stability beyond 14 months at room temperature.

---

# 4. Key Findings and Outcomes

The project achieved every core scientific objective, demonstrating that rapid, field-based DNA detection is both feasible and accurate across multiple species. The technology consistently produced clear, binary results in under twenty minutes, with laboratory-level sensitivity and specificity.Early versions of the platform used liquid reagents. Subsequent engineering incorporated dried reagents to improve stability and field reliability, with the dried-reagent platform subsequently demonstrating stability beyond 14 months at room temperature.Multiplexing confirmed that up to three species can be detected on a single lateral-flow strip, and genetic sexing provided an additional layer of biological insight.

Following successful laboratory validation, the platform was deployed by Environment and Climate Change Canada (ECCC) in a national pilot to detect illegally traded European eels — the first operational use of a Canadian-developed portable DNA device in an enforcement setting. The study confirmed the test's potential to deliverrapid, on-site detection of target species DNAbut also revealed valuable areas for refinement.

ECCC's evaluation identified challenges with workflow complexity, component handling, and reagent performance under field conditions, particularly when users operated outside controlled laboratory environments. Importantly, no false negatives were observed during the pilot, confirming the assay's strong sensitivity and reliability for species detection. However, a small percentage of false positives occurred, which were later confirmed in laboratory testing. These were attributed to evaporation of liquid reagents, which can alter reagent concentration and, in turn, affect test efficacy.

These findings were instrumental in shaping the subsequent engineering phase.

In response, subsequent engineering focused on two concrete changes:

- A streamlined three-step workflow so non-specialists can run the test reliably under field conditions.
- Dried reagents to eliminate evaporation issues reported by ECCC, improving stability and performance in variable temperatures and humidity.

These targeted updates preserve the platform's core strengths — speed, specificity, and portability — while directly addressing what field users told us they need most: fewer steps and more robust chemistry under real-world conditions.

Beyond caribou and eel, assays were also developed for snow leopard and other species of conservation or enforcement relevance, illustrating the adaptability of both the underlying chemistry and the AI-assisted primer-design pipeline. Together, these advancements form the foundation for a new generation of rapid, reliable biodiversity-detection tools that can meet the practical needs of users working in the field.

---

## 5. Broader Impacts and End-User Value

Building on laboratory validation and feedback from the national eel pilot, the project has progressed from research to application — demonstrating how portable DNA testing can provide trusted molecular evidence directly in the field. The technology's speed, affordability, and ease of use have created new pathways for conservation, enforcement, and community-based monitoring, where access to verified species data has traditionally been limited.

Interest has since expanded across sectors. Chuo University in Japan became the first international adopter, applying the test for seafood provenance research and illustrating its potential for global food-authenticity markets. Within Canada, the BC Caribou Recovery Program and the NBCKC Indigenous Knowledge Circle have expressed interest in adapting the technology for culturally significant species such as caribou, moose, and salmon — highlighting how field-ready molecular tools can complement Indigenous stewardship and Guardian programs.

In parallel, The Nature Conservancy is planning to fund pilot studies that incorporate the platform for eDNA and invasive-species monitoring, enabling assessment of its broader ecosystem-management value.

Together, these developments demonstrate how Alberta Innovates–supported research is evolving into a practical solution that can empower end-users to generate molecular data in real time — enhancing biodiversity monitoring, strengthening compliance, and improving decision-making across conservation and regulatory contexts.

As the technology matures and new pilot opportunities emerge, the project is shifting focus from validation to knowledge exchange — ensuring that lessons learned are shared widely with partners, researchers, and end-users who can build upon this foundation.

---

# 6. Knowledge Mobilization and Recognition

Knowledge mobilization has been at the heart of this project — ensuring that innovations born in Alberta's labs reach the field, the policy table, and the global conservation community.

Across Canada, the team shared progress and insights through presentations at the Toronto Zoo and the Northern Boreal Caribou Knowledge Consortium (NBCKC), engaging researchers, government partners, and Indigenous representatives in exploring how portable DNA tools could strengthen wildlife recovery programs. A Genome BC workshop on eDNA technologies, co-led by WildTechDNA, brought together stakeholders from academia, NGOs, industry, and Indigenous communities to discuss barriers and opportunities for implementing rapid molecular detection in the field.

At the academic level, collaborators at the University of Calgary published foundational research on caribou genomics and biosensing — including peer-reviewed papers in *Conservation Genetics* and *Angewandte Chemie* — that continue to underpin the project's scientific credibility. Two additional manuscripts are in preparation: one led by Letizia Dondi describing a rapid, field-applicable DNA-extraction method, and another detailing the integrated testing device (pending patent completion).

Internationally, 2025 marked a year of major visibility and engagement. The technology was featured at the Global Snow Leopard and Ecosystem Protection Program (GSLEP) Ministerial Steering Committee, where range-state governments coordinate snow-leopard conservation across twelve countries. There, it was presented as a potential breakthrough for detecting elusive mountain species through non-invasive samples such as scat.

In the same year, WildTechDNA co-hosted technical workshops in Tokyo with Chuo University and partners from government and civil society, highlighting applications for seafood-provenance research and biodiversity monitoring. The platform was also presented at a side event during the 2025 CITES Standing Committee, positioning the technology within one of the world's most influential environmental policy frameworks — the *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)* — as an innovative tool to strengthen traceability and compliance in global wildlife trade.

Recognition for the project and its leadership has grown in parallel. WildTechDNA's founder was named to the Explorers Club EC50 (2022) and received Canada's Clean50 Award (2025), honours that celebrate both scientific innovation and measurable environmental impact.
Together with invitations to present at the Global Snow Leopard and Ecosystem Protection Program (GSLEP) Ministerial Steering Committee Meeting, the Convention on International Trade in Endangered Species (CITES) Standing Committee Meeting, and other leading academic forums, these milestones reflect how work initiated through Alberta Innovates support has evolved into a global platform influencing the future of conservation biotechnology.

Collectively, these outreach efforts—spanning research, community engagement, and international diplomacy—have positioned WildTechDNA and its Alberta collaborators at the forefront of a new generation of field-ready molecular tools for conservation and sustainability.

---

# 7. Challenges and Lessons Learned

The path from idea to impact was rarely linear. Each phase — from early laboratory work through field testing and international outreach, revealed new challenges that shaped both the technology and the team's understanding of how innovation succeeds in the real world.

## 7.1 Laboratory and Field Challenges

The journey from concept to field-ready tool was far from straightforward. When the pandemic struck, laboratories shut down, supply chains broke, and progress slowed to a crawl. For nearly two years, experiments were delayed or halted altogether, forcing the team to rethink how to make testing simpler, faster, and less dependent on fragile reagents or specialized equipment.

When work finally resumed, the team discovered that what worked perfectly in a temperature-controlled laboratory didn't always translate to the real world. Early chemistries sometimes gave unreliable results when conditions shifted, too cold, too hot, or too humid. Through months of trial and error, each failure became a lesson. The chemistry was gradually rebuilt and simplified so it could perform more consistently and move closer to being stable without refrigeration, an innovation born of constraint that became one of the platform's most valuable features.

Testing the prototype in northern British Columbia, where winter temperatures dropped below –40 °C, brought another layer of reality. Those experiences underscored the importance of designing a system that anyone could use, anywhere: rugged, reliable, and intuitive. More than just a scientific challenge, it was a reminder that success in technology development depends as much on perseverance and adaptability as on discovery itself.

## 7.2 Engagement and Co-Design

Early discussions through the Northern Boreal Caribou Knowledge Consortium (NBCKC) and provincial partners have begun to open pathways for collaboration with Indigenous communities interested in testing the technology for culturally significant species such as caribou, moose, and salmon. While these partnerships are still emerging, they have already highlighted the importance of co-design and trust-building, ensuring that future versions of the platform are intuitive, culturally relevant, and adaptable to community-led monitoring.

## 7.3 Scale, Manufacturing, and Cost

As prototypes matured, new challenges arose in balancing reliability with affordability. Producing consistent, high-quality components at scale requires specialized manufacturing partners and early regulatory guidance. These lessons are now shaping plans for collaboration with contract manufacturers and for standardized component design that supports low-cost production.

## 7.4 Strategic Focus and Market Path

The technology's versatility, spanning wildlife monitoring, trade enforcement, and food provenance, created both opportunity and complexity. Through dialogue with government, academic, and industry partners, the team recognized the need for a clear, phased approach to commercialization. Focusing first on seafood provenance offers a defined regulatory framework and global relevance while allowing engineering and validation to advance in a single, high-impact market before expanding into conservation and community applications.

### 7.5 Broader Lessons

Perhaps the most valuable insight has been that innovation grows through challenge. COVID-19 delays, chemistry failures, and frozen field tests were not setbacks but stepping-stones that strengthened the technology and the people behind it. The experience showed that effective conservation tools must be scientifically sound, resilient, and grounded in relationships, with end-users, communities, and ecosystems alike. Each lesson has helped build a stronger foundation for the next generation of devices designed for real-world impact.

---

## 8. Future Opportunities and Path to Commercialization

The lessons gained through this project have created a clear roadmap for the next phase of development. What began as an ambitious research challenge is now evolving into a practical, deployable tool with applications that reach far beyond the laboratory. Each round of testing, feedback, and redesign has refined not only the technology itself but also the team's understanding of where it can have the greatest impact.

Building on the progress achieved under Alberta Innovates support, the focus now shifts to real-world deployment and commercial readiness. The current platform integrates the insights learned from laboratory setbacks and field trials: a simplified workflow, dried reagents with demonstrated stability beyond 14 months at room temperature, and an electronics-free, field-ready format. Together, these improvements deliver a rugged, affordable test designed for reliable use in remote and resource-limited settings without dependence on electronic equipment.

### 8.1 Indigenous and Community Engagement

Interest continues to grow among Indigenous communities and stewardship programs across western and northern Canada, particularly through the BC Caribou Recovery Program and discussions within the Northern Boreal Caribou Knowledge Consortium (NBCKC). These early engagements have identified species of cultural and ecological significance, including caribou, moose, and salmon, as potential candidates for future pilots.
The next step will involve co-design and field validation with interested communities to ensure usability, cultural relevance, and shared data stewardship. In the longer term, such collaborations could help integrate the technology into Indigenous Guardians programs, empowering local monitoring and decision-making through real-time molecular evidence.

### 8.2 Regulatory and Enforcement Applications

The national European eel pilot with Environment and Climate Change Canada (ECCC) provided proof that portable DNA testing can delivertrusted results for target species detection at enforcement checkpoints. Building on that success, discussions are now underway with the CITES Secretariat and other international partners to explore how similar tests could strengthen

traceability and compliance for wildlife trade.
There is also potential to align with Alberta's fisheries and environmental monitoring programs, demonstrating how locally developed biotechnology can support national and provincial conservation priorities while reinforcing Alberta's leadership in clean-technology innovation.

### 8.3 NGO and Conservation Partnerships

The Nature Conservancy (TNC) is planning to fund pilot studies that incorporate WildTechDNA's platform for eDNA and invasive-species monitoring. These pilots will assess workflow integration, usability, and accuracy under real ecosystem-management conditions. Other NGOs and research institutions have expressed interest in collaborating on similar evaluations, helping to generate the data and confidence required for broader deployment.

### 8.4 Commercial Pathway and Scaling Strategy

Transitioning from a validated prototype to a market-ready product presents both opportunity and challenge. The immediate commercial focus is seafood provenance, a market with clear regulatory demand, defined customer groups, and global relevance.
Building on pilot collaborations with Chuo University (Japan) and supported by Canada's Trade Commissioner Service, WildTechDNA will refine and validate assays for key seafood species traded internationally. This focus allows the company to develop a reliable commercial workflow while maintaining the flexibility to adapt the platform for future biodiversity and One-Health applications. Achieving commercial scale will require partnerships in manufacturing, regulatory validation, and quality assurance to ensure consistent performance across environments and user groups.

### 8.5 Challenges in Scaling

Scaling a biotechnology product from the laboratory to market brings predictable challenges, standardizing production, maintaining affordability, and ensuring equitable access. The team remains committed to balancing commercial success with public-good applications by reinvesting a portion of future revenues into community-based conservation pilots and technology access for under-resourced partners.

---

## 9. Benefits to Alberta

This project demonstrates how investment in Alberta-led innovation can generate both environmental and societal benefits. By translating laboratory research into a portable, field-ready biotechnology, it showcases Alberta's capacity to deliver practical solutions that directly support sustainability, regulatory compliance, and biodiversity protection.

The technology reinforces Alberta's leadership in clean resources and conservation innovation, aligning with the province's goals to diversify its economy through science-based, low-impact technologies. Because the device is small, affordable, and adaptable, it can be used across Alberta's landscapes , from reclamation zones and caribou ranges to fisheries and communitymanaged areas , providing immediate, verifiable data to guide management and restoration decisions.

It also advances Alberta’s environmental commitments by improving the speed, accuracy, and affordability of biodiversity assessments. This can reduce monitoring costs for industry and government, enable earlier detection of ecological change, and support evidence-based decision-making for conservation and resource management.

Finally, the project’s collaborative model , linking academic research, government agencies, and Indigenous and NGO partners , reflects Alberta’s strength in cross-sector innovation for the public good. By investing in practical, field-based technologies that strengthen stewardship, transparency, and community participation, Alberta Innovates is helping to build the foundation for a new generation of conservation biotechnology whose impact will extend well beyond the province’s borders.

---

## 10. Figures and Visuals

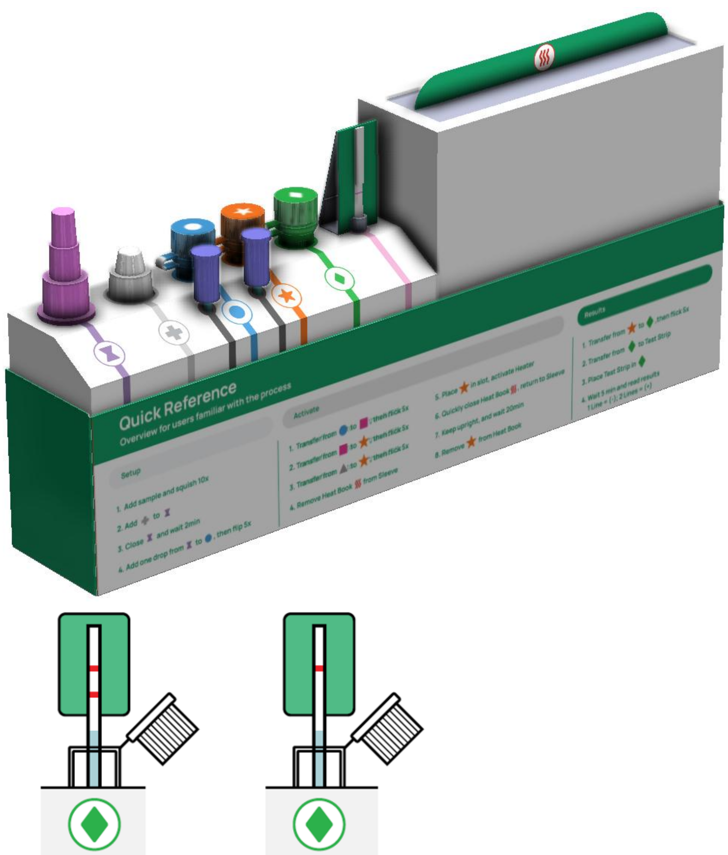



Figure 1. First prototype lab in a box technology with disposable heating device and lateral flow strips showing a positive and negative result.

Figure 2. Historical engineering concept for a proposed next-generation version of the technology incorporating a rechargeable heating platform. This concept was not adopted; subsequent development moved to an electronics-free platform.

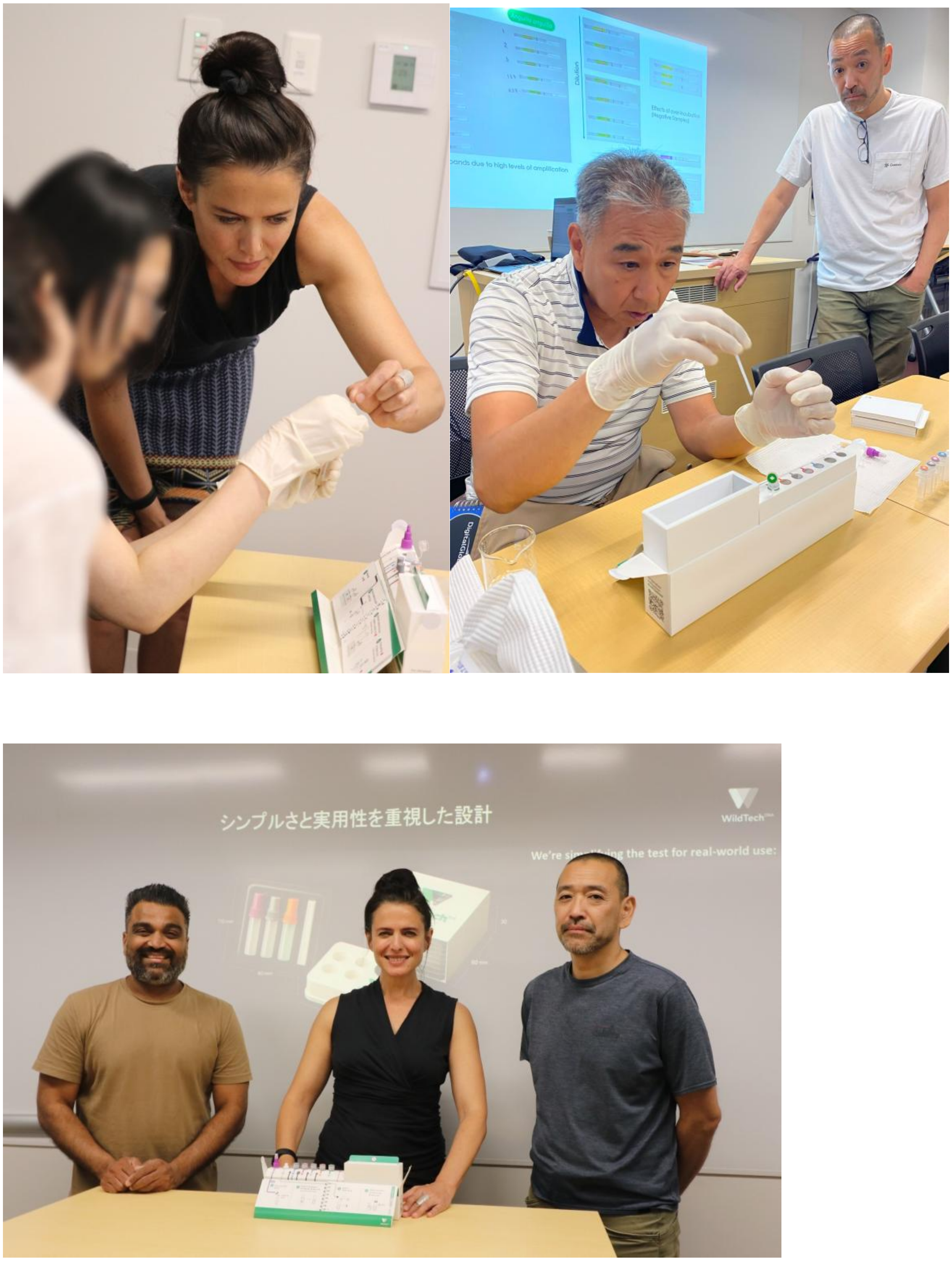

Figure 3. Design of next version of the technology with a disposable heating option, making the test fully disposable.

Figure 4. Lateral flow strips showing clear positive results for caribou, snow leopard, and European eel, with negative results for non-target species that are commonly confused in the field.


Figure 5. First field test of methodology in 2024 in far northern BC with the BC Provincial Government and Fort Nelson First Nations.

Figure 6. Training Canadian Government enforcement officers (ECCC) to use our first prototype technology for a Canada-wide enforcement blitz on European eel.

Figure 7. Tokyo workshop at Chuo University teaching government, academic and industry representatives how to use our first prototype technology.



# 11. Acknowledgement of Alberta Innovates Support

The project team gratefully acknowledges **Alberta Innovates – Clean Resources Program** for funding and strategic guidance. This support enabled the translation of laboratory research into a field-ready platform with direct applications to Alberta's conservation and reclamation priorities. We also thank COSIA, NSERC, and WildTechDNA for their critical partnership in achieving these outcomes.