CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

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A PORTABLE, AFFORDABLE AND ACCESSIBLE DNA RAPID DIAGNOSTIC TECHNOLOGY FOR SPECIES DETECTION

This document has been submitted by Mexico in relation to agenda item 37.[1]

[1] *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

A portable, affordable and accessible DNA rapid diagnostic technology for species detection

This technology uses cutting-edge developments in biomedical research and applies them to conservation. This project is headed by WildTechDNA Inc in collaboration with McMaster University bioengineering and biomedical sciences, and is based on 8 years of work backed by over 20 years of biosensor research. Our goal is to simplify, revolutionize, and improve the way conservation is conducted, from the field to customs points of entry, to law enforcement in sea, air, and land species.

Finding effective ways to monitor species that are difficult to detect is of paramount importance to national and global conservation efforts and becoming increasingly more urgent.

Detecting wildlife from the DNA profile of their parts, products, and subproducts has become a critical method in conservation to provide this information that would otherwise be difficult or impossible to obtain through other means. Currently, DNA retrieved from materials (e.g., feces, skin and bone) collected in the field need to be analysed using traditional methods in the lab or using expensive and complex portable DNA sequencers. Unfortunately, many challenges in these methods limit the widespread adoption of genetic species detection including:

1. they are time-consuming and require specialized expertise;
2. the samples' age and quality can impact the accuracy of the analysis which is a consistent issue with most CITES sample types (e.g. processed skin, bone, dried shark fin etc) ; and
3. laboratory costs are too high for large-scale studies or for regions that do not have access to the latest costly equipment.
4. many countries have legal restrictions on the exportation of samples and are therefore limited in their capacity to contribute to wildlife monitoring without specialized laboratories in the country.

Such challenges prevent the inclusion of a major segment of the international conservation community, the public, and also prevent many developing countries (often hotspots of biodiversity) from playing a significant role in conservation efforts due to socio-economic reasons.

Our approach/current status

Through funding from the Canadian government and industry we have developed and field-tested a revolutionary portable, affordable, accessible DNA methodology for the **real-time detection of wildlife species and sex, from feces and tissue**. The technology has been developed for the targeted detection of caribou and other Canadian cervids and provides results for fecal and tissue

samples with 100% specificity, high sensitivity (5-10 DNA copies/mm3 of sample) and in under 30 minutes. We are also close to finalising genetic marker development for the detection of the *Panthera* species, as well as cougar, cheetah, wolf, fox and hyena.

The method consists of sample preparation and DNA extraction using gravity filtration (5 minutes), advanced DNA amplification that is simple, rapid, highly specific and sensitive (15 minutes) and lateral flow visualisation (5-10 minutes) (Figure 1). Our amplification method is also more tolerant to inhibitors present in many CITES specimens compared to conventional PCR, is orders of magnitude more sensitive, is more effective in dealing with degraded, fragmented DNA, requires no expensive heating devices and **has a high deployment potential to resource-limited settings**.

CITES applications

"If successful, this technology will provide a powerful revolutionary tool for the real time detection of illegally trafficked wildlife products, thereby dramatically increasing the capabilities of customs and law enforcement entities to detect and respond to illicit trade."

Carmel Mbizvo, Acting Chief Executive Officer, SANBI (South African National Biodiversity Institute)

Currently, suspected illegally trafficked biological remains are either sent to an external lab for identification or cannot be identified due to the unavailability of these facilities. Our technology has the potential of providing an important missing link empowering customs and law enforcement officers on the front line to make quick decisions on CITES-listed species as well as collecting evidence for prosecution. It is also a tool that could be used by labs dedicated to sample identification that could save considerable time and money. Genetic forensic tools like ours will strengthen the capacity of law enforcement officers, especially in the Global South, to use innovative law enforcement and investigative methods and techniques in line with Resolution Conf. 11.3 (Rev. CoP19), paragraph 9 and as an addition to the toolkit developed by the ICCWC. Our technology will also help with the daily efforts of law enforcement and custom officials who struggle with identification within the legal trade of CITES specimens.

Side by side our technology solves many problems faced by even other portable technologies used in the identification of legal and illegal specimens under CITES (e.g. portable qPCR machines)

	Portable qPCR	**Our technology**
cost per unit	~$10000	$50
cost per reaction	~$1	~$1-5
sensitivity	1 DNA copy	5-10 DNA copies
amplification impacted by inhibitors	yes	no
total run time/sample	~110 minutes	~30 minutes
expertise needed	medium	low
sample preparation/DNA extraction	30-45 minutes	5 minutes
works well with crude lysates	no	yes

Next steps and partnerships for expansion

- Working with an engineering company we have completed our first prototype device platform. This platform includes all components of the methodology minus the species-specific primers, with future iterations of the design guided by end-user interviews and field trials with end-users.
- We have partnered with a bioinformatician at London's Natural History Museum to create an AI-driven blueprint for genetic marker design to enable research groups to quickly develop markers for their species of interest in combination with our technology platform.
- We are looking for stakeholders interested in beta-testing our technology and provide feedback to help us automate and improve our technology to ensure that it can be useful for a variety of end-users.

Product Prototype

Support and testimonials

“South Africa is very active within the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and, as such, needs to comply with the convention. Of particular interest, is the rapid identification of bone and other parts of lion and other species. The South African government gives SANBI and the Barcode of Wildlife Project, South Africa their full support to help us develop the technology for the big cats by providing in-kind support. SANBI is the premiere biodiversity information clearinghouse in Africa. Partner – Michele Pfab (Scientific Coordinator).”

Michele Pfab, Scientific Coordinator, SANBI

“Current methods in genetic sampling and analysis have issues that prevent them from being utilized across [snow leopard] range countries including restrictions on exporting genetic material to other countries for analyses, slow and/or expensive processing to extract information about species of origin from genetic materials, and lack of capacity to conduct genetic analyses locally.

The proposed project’s success could lead to substantial conservation benefits, especially to threatened and/or heavily trafficked species…..we see huge potential on developing it for species of interest in Central and South Asia.”

Dr. Koustubh Sharma, International Coordinator
Global Snow Leopard Ecosystem Protection Program (GSLEP)

“This technology is nothing short of a game-changer. This is a powerful, revolutionary tool for the real time detection of species with lots of potential to be applied to all sorts of conservation and management questions and policies.”

Dr Rodrigo Medellin, Senior Professor of Ecology, Autonomous University of Mexico and Vicechair of the CITES Animals Committee, 2004-2016

“The hand-held paper-based biosensor will completely democratize the ability to collect [species and population] information, dramatically expanding the capacity of stakeholders to make on-the-spot management decisions and extending their monitoring abilities.....We can also see this device as the beginning of a new paradigm in environmental monitoring by enabling participation by the general public – in essence, enabling crowd-based monitoring. With the ultra-low-cost of the device, communities, schools and individuals can directly participate in conservation efforts. One of the goals is to create a device that can be operated by a non-trained person and to design it in a way that can be easily produced. Such advancement in technology will enable us to learn much more about the impact of industrial operations and other anthropogenic effects on the environment.”

Scott Grindal, Representative and Senior Environmental Coordinator
Canada’s Oil Sands Innovation Alliance (COSIA)

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