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

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Seventeenth meeting of the Conference of the Parties
Johannesburg (South Africa), 24 September – 5 October 2016

# NEW FORENSIC METHODS AS TOOL FOR CITES ENFORCEMENT- ISOTOPE ANALYSES WWW.IVORYID.ORG

1. This document was submitted by Germany* in relation to the following agenda items: 25 on *Enforcement matters*, and 57.1 *on Implementation of Resolution Conf. 10.10 (Rev. CoP16) on* Trade in elephant specimens.

2. Exact methods for the determination of the age and geographical origin of ivory are essential to meet the unsolved problem of smuggling and false origin and age declaration. Especially when species are under high pressure, driven by demand, the development of efficient enforcement tools are necessary to fight against unsustainable use.

3. The methods described in this document resulted from the scientific study 'Determination of age and geographical origin of African elephant ivory', initiated by the German Federal Agency for Nature Conservation.

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* *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.*

## 1. A unique reference database

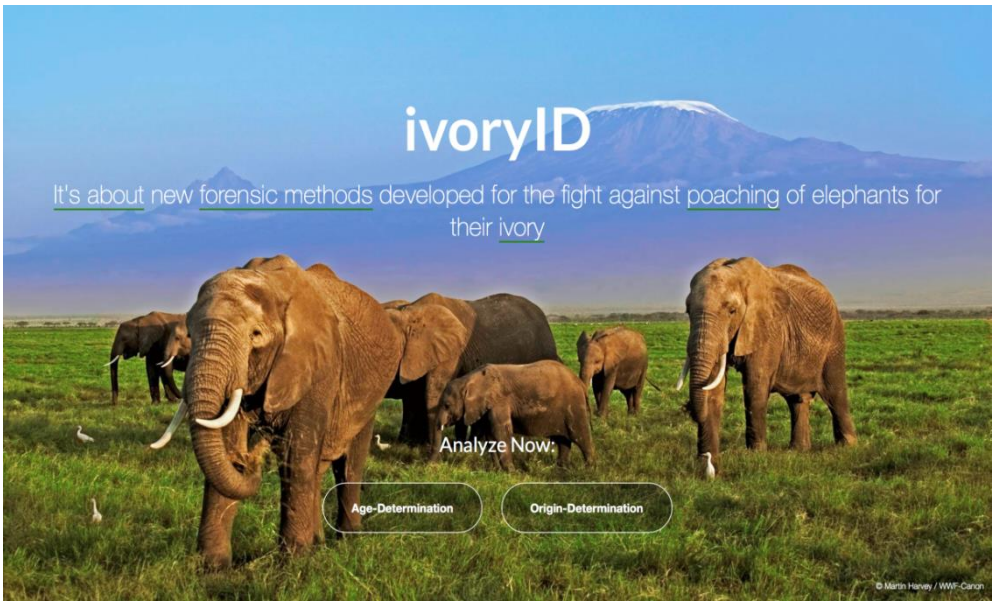


Fig. 1: IvoryID Website

The website **www.ivoryID.org** …

…includes

- the **reference data** from more than **700** ivory samples with verified geographical origin from 30 Asian and African range states.
- all information about the **methods.**
- a not closed list of **laboratories** able to use the method.
    - a small interlaboratory test, initiated by our project partners, with only European laboratories is completed. Another international interlaboratory test was initiated by the IAEA but has not been completed yet. The list of laboratories will be amended regularly.

…is for **open** access, **free** of costs and **usable** for all (follow the manual on the website).

…enables you to type in the analysis results of your ivory sample and then get **scientifically proven** information about the origin and the age of your sample.

…can save your results in the database under **your personal account** which allows you e.g. retracing trafficking chains and identifying poaching hot spots (see our open seizure data).

We invite you to have a closer look at this new enforcement tool at **www.ivoryID.org** . We thank all parties for their support and further encourage countries to provide ivory sample of known origin to refine the database.

## 2. Isotope analysis as enforcement tool for CITES ?!

Isotopes are different types of the same element which differ in the number of their neutrons in the nucleus. The composition of different isotopes in animal or plant tissue is characteristic for the geographical environment of the habitat. Isotopes are included in water soil, air and food. Animals absorb these isotopes by eating, drinking and breathing. After the death of a living being some isotopes stay stable over thousands of years while others decay radioactively with a half-life time of only some years. This last characteristic is useful to determine the time of death of an animal.

Enforcement of CITES as well as monitoring and controlling the sustainability of trade with protected species in general rely on methods which allow a determination of the age and the geographical origin of the traded species.

To say it short: Isotope analysis can give information about the country of origin and the time of death of an animal. Furthermore a new research project, initiated by Germany's Federal Agency for Nature Conservation, shows promising results for the applicability of the isotope analysis for the purpose of distinguishing between wild and captive bred reptile populations [3,6].

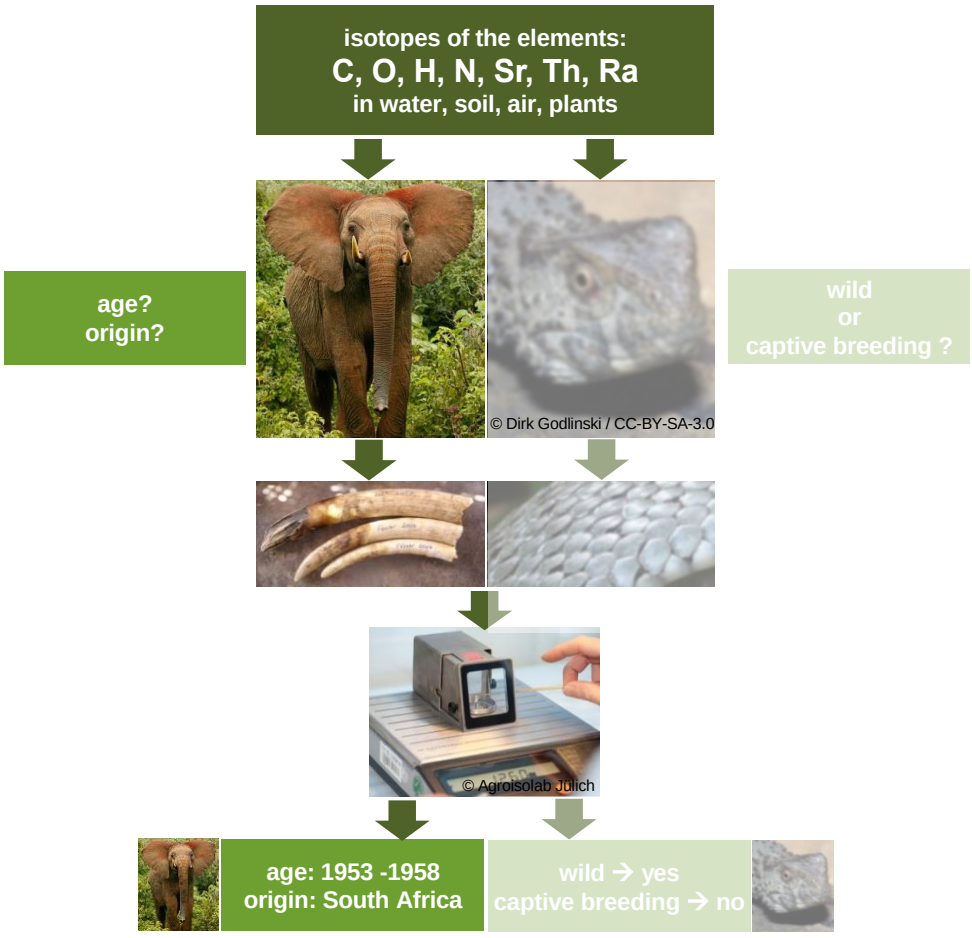


Fig. 2: Approach of isotope analysis for CITES enforcement

## 3. Short summaries:

### Determination of geographical origin of ivory

Nowadays it is common use to trace the origin of foods by analyzing their isotopic composition. By this it is possible to investigate if the declared country origin of e.g. an apple is the real origin or if the certified organic product is really from organic farming. The method uses the fact that biomass is generated of the materials available in the respective local environment with its typical isotopic composition (see above).

But would this also work for ivory? If yes, it would be an excellent system for tracing the origin of smuggled ivory and identifying poaching hotspots to be able to take effective measures for the protection of elephants. The research project 'Determination of Age and Geographical Origin of African Elephant ivory' conducted between 2010 and 2016 by the German Federal Agency of Nature Conservation in cooperation with WWF Germany validated that this method can also be applied for the identification of the origin of ivory [7]: A new, precise method to determine the provenance of ivory by using the isotopic signature of the elements carbon (C), nitrogen (N), oxygen (O), hydrogen (H) and sulphur (S) was developed.

Like described above elephants ingest isotopes with the food. The composition of the isotopes is characteristic for the geological, biological and geographical matters. Carbon and nitrogen isotopes for example can serve as indicators of the nutritional composition of the climate zone. A very low $\delta^{13}C$ ratio for example indicates densely forested habitats, a high ratio is indicative for savannah landscapes. In a similar way, a low $\delta^{15}N$ ratio suggests humid conditions, whereas in drier elephant habitats a rather high ratio can be expected. Hence a relatively correct determination of origin is possible by defining the composition of the tusks. The whole method is based on a reference database providing standard values from over 700 reference samples from 30 African and six Asian elephant range states.

## Determination of the age of ivory

……by using additional isotopes like strontium and thorium, why?

The radio carbon testing $^{14}C$ is already an established method for determining the age of ivory. It is based on the fact that carbon, which naturally occurs as the isotopes $^{14}C$, $^{13}C$, $^{12}C$, is ingested by the elephant from the atmosphere during its lifetime. Without human impact the composition of the different carbon isotopes in the atmosphere could be assumed as constant. But the nuclear testing in the 50ies and early 60ies had a large effect on this. The so called “bomb curve” shows the increase of the $^{14}C$ proportion in organic material.

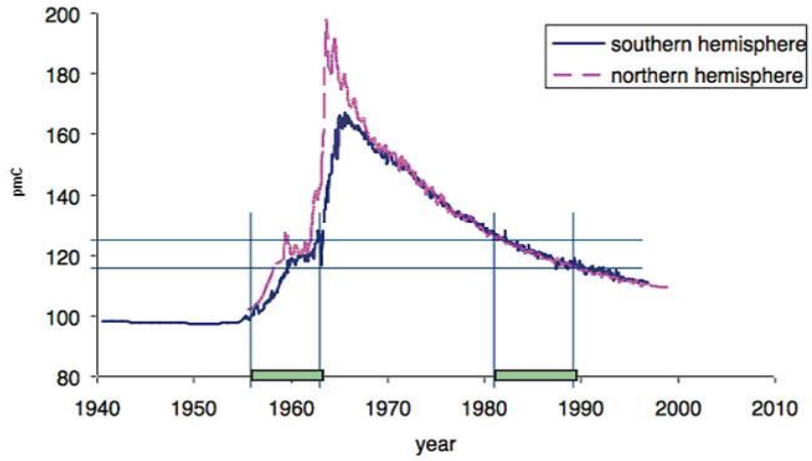


Fig. 3: $^{14}C$ bomb curve (pmC) which delivers two periods $t_1$ and $t_2$ (Schupfner, University of Regensburg)

Measuring the $^{14}C/C$ ratio of ivory by using the bomb curve as reference usually gives information about the age of ivory. But due to the shape of the bomb curve in many cases one $^{14}C/C$ ratio delivers two possible values for the time of death of the elephant (see figure above). Additionally recent research of the University of Regensburg in Germany [1] show that even pre-convention ivory (before 1973) is no further distinguishable from new, e.g. freshly poached ivory because the $^{14}C/C$ ratio has already reached values like before the nuclear weapon tests.

The development and validation of further analyses was necessary to get unambiguous results for the age of ivory. Within the research project ivoryID two dissertations concentrate on the development of a combined dating method for ivory using the isotopes of carbon (C), strontium (Sr) and thorium (Th).

- The thorium isotope $^{232}Th$ and the radon isotope $^{228}Ra$ are ingested by the elephant. While the activity of $^{232}Th$ with its half-life period of more than 14000 millions of years could be assumed as constant, $^{228}Ra$ decays into $^{228}Th$ with a half-life period of seven years. The ratio of $^{228}Th$ /$^{232}Th$ therefore gives a hint if the death of the elephant happened recently or already several decades ago [2].

- $^{90}Sr$ was distributed during the global nuclear fallout and absorbed within the food chain in the 1960s as well as $^{14}C$. It behaves very similar with calcium and is therefore transferred to calcium containing tissues like ivory. The bombing curve of $^{90}Sr/Ca$ is of similar shape as the $^{14}C/C$ bombing curve and allows the assignment of two age periods to the ivory samples [4].

Result: In some cases measuring $^{14}C/C$ already gives an unambiguous result for the time of death of the elephant. But if the results are not unambiguous measuring the $^{90}Sr/Ca$ and $^{228}Th$ /$^{232}Th$ ratio is necessary[5].

A more detailed overview of this method could be found on www.ivoryID.org .

## References


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