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Reference Database to Identify Origin of Elephant Ivory

Working in collaboration with the World Wide Fund for Nature (WWF) and the Bundesamt für Naturschutz (BfN, German Federal Agency for Nature Conservation), and with the support of the International Council for Game and Wildlife Conservation (CIC), a team of scientists at Johannes Gutenberg University Mainz is preparing an innovative reference database that allows the identification of the origin of elephant ivory.

By means of analysis of the isotope profile of samples of known geographic origin, it is possible to prepare an "isotope map" for this material and thus determine the original provenance of any piece of ivory. The project is thus not only making a worthwhile contribution towards the suppression of the illegal trade in ivory but is also helping to protect an endangered species.

Analysis of the levels of accumulation of isotopes of specific elements provides reliable evidence of the origin of materials such as ivory and bone fragments. Isotopes are atoms of one and the same chemical element that differ in terms of their atomic mass. Organic materials derived from creatures that live in specific biotopes are characterized by the presence and the relative concentrations of certain isotopes of chemical elements. The element carbon, for example, consists in its natural state of three isotopes with different atomic masses, namely 12C, 13C, and 14C. Low concentrations of the heavy carbon isotope 13C indicate that the material sample originates from a thickly wooded habitat, while high levels are indicative of a savanna landscape.

Such factors are used for the purpose of so-called provenance analysis. Living beings take up elements with their nutrition that have an isotope signature characteristic of their more immediate living environment; they then incorporate these elements into their own body substances, such as dental enamel. The analysis of the isotope profile of such materials can thus provide evidence of the precise origin of the sample in question. Although previous research had shown that isotope analysis can be used to determine the provenance of ivory, no attempts have yet been undertaken to prepare the detailed isotope maps that would enable the relative geographic origin of a particular ivory item to be pinpointed.

Since 1995, the International Union for Conservation of Nature (IUCN) has regularly been conducting surveys of and publishing status reports on the numbers and distribution range of elephants in Africa. In addition to information on the geographical spread of these animals, the reports also contain data on the geology, vegetation, and rainfall in the regions in question, providing the basis for the development of a reference database. Historical ivory items of known or "georeferenced" origin from collections worldwide are being used to extend the database: The isotope signature of a sample is analyzed and its 'topographic' provenance defined, while geostatistical techniques, such as, kriging are used for plotting purposes. The resultant isotope maps can be used to determine the region of origin of any sample of ivory.

Trade as necessity -- the necessity of trade

The international trade in ivory has resulted in a dramatic decline in animal numbers in many African countries since the 1980s. In order to protect Africa's elephant population and as a result of an international accord, the African elephant was added in 1989 to Appendix I of the Washington Convention on International Trade in Endangered Species (CITES), and all commercial trade in ivory was thus banned. Thanks to the imposition of strict trade controls and effective protection measures, elephant populations in some African countries have significantly recovered. In countries

such as Botswana, Namibia, Zimbabwe, and South Africa, limited trade in ivory products is permitted, although stringent restrictions are imposed. But the countries of the southern part of Africa in particular are increasingly arguing that they should be allowed to trade freely in ivory from the stocks they already hold so that they can raise the finances they urgently need for nature conservancy measures. Unfortunately, this method of generating income would not be without its problems: If free trade is permitted, it would become increasingly difficult to differentiate between legal and illegal ivory at the point of sale and the legalized trade could be used as a cover for ivory smuggling and poaching. Isotope maps provide an effective way of resolving this dilemma.

Working under the aegis of the German Federal Agency for Nature Conservation (BfN), the International Center of Ivory Studies (INCENTIVS) at the Institute for Geosciences at Johannes Gutenberg University Mainz is collaborating with the WWF in this joint project. The project is being partly financed by Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit), and is receiving the active support of the International Council for Game and Wildlife Conservation (CIC).