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Estación Biológica Doñana

NOTA DE PRENSA

Hair analyses reveals the hidden history of forests

- **Researchers from Poland, Spain and Canada analyse changes in hair stable isotope composition. These are "markers" that can track changes in the environment.**
- **Changes observed during 66 years can be related to the use of fertilizers and the raising global temperatures**

Białowieża Forest, at the Polish-Belarusian borderland, hosts a high species richness. The mammal community is close-to-complete for the central European lowlands. It comprises five ungulate species, including the largest population of European bison and two large carnivores - wolf and Eurasian lynx. Photo-credit: Adam Wajrak.

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Sevilla, 5th december 2023. Forests are threatened not only by logging, but also by “invisible” forces of global change. Human activities are profoundly transforming the Earth's environment through a suite of factors collectively resulting in global change. The concentration of CO_2 in the atmosphere has doubled in the past 150 years and global temperatures are on the rise. In spite of international agreements to abate pollutant emissions, the deposition of nitrogen, mostly from industrial fertilizers for agriculture, is still high. A study just published in Global Change Biology shows that mammals inhabiting natural forests can act as canaries in the coal mine, providing warning signals of these changes. As tree rings or pollen preserved in peat, animal tissues, like hairs or bones, record environmental conditions when they were formed.

Researchers collected hairs from the whole mammal community of Białowieża Forest (NE Poland), consisting of 50 species, from European bison to shrews. Most samples came from the strict reserve of the Forest, which is the most primeval part of this best-preserved lowland temperate forest in Europe. Hairs came mostly from specimens, trophies and skins in museum and private collections dated as early as 1946 till 2011. The investigators gathered at least 50 mammal hair samples per decade and covered carnivores, herbivores, insectivores and bats (the only flying mammal). Hairs were analysed for nitrogen and carbon stable isotope analysis, which are “markers” preserved in animal tissues that can track changes in the environment.

The most notable finding of the study was a clear decrease in hair nitrogen isotope ratio, particularly abrupt from 1970. “This trend is in line with nitrogen deposition in Europe, which was highest in 1970s-80s. But it is also consistent with observed declines of nitrogen concentration in the leaves of Białowieża forest trees”, explains Keith Hobson, co-author of the study and isotope expert. These results align with other studies which have found that nitrogen availability has decreased in natural forests, meaning that the nutritional value of forest plants is also decreasing. “Although we lack the data to confirm this hypothesis, we found the strongest decline in herbivores, which may suggest that this reduced nutritional value of the vegetation may be passing on to consumers. This decrease of food quality could have serious consequences for the growth, survival and reproduction of mammal populations in the long-term. This aspect deserves further research”, added Nuria Selva, lead author of the study.

The study also showed that mammal hairs perfectly mirrored the increase in global fossil fuel emissions in the last seven decades. “The carbon isotope ratio of mammal hairs showed the same declining trend as in the atmosphere due to fossil fuel burning”, said José Antonio Donázar, co-author of the study. “Once we corrected for this, known as the Suess effect, the hair carbon isotope ratio showed instead an increasing trend, which may be explained by the increasing frequency of dry years”, he added.

This is the first comprehensive, broad-scale, and long-term mammal isotope ecology study in a near-primeval forest in Europe. “Well-preserved forests, like Białowieża, can act as sentinel ecosystems of environmental changes. Investigating the isotopic temporal variation of entire mammal communities in such reference ecosystems can help detecting invisible impacts in a more holistic way than single-species approaches and foreseen upcoming changes.”, add Selva.

This research is the result of a collaboration among researchers of the Institute of Nature Conservation and the Mammal Research Institute of the Polish Academy of Sciences, Estación Biológica de Doñana CSIC and Universities of Sevilla and Huelva in Spain, and Environment and Climate Change Canada and the University of Western Ontario in Canada.

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Nuria Selva, Keith A. Hobson, Andrzej Zalewski, Ainara Cortés-Avizanda, José Antonio Donázar. *Mammal communities of primeval forests as sentinels of global.* Global Change Biology. https://doi.org/10.1111/gcb.17045

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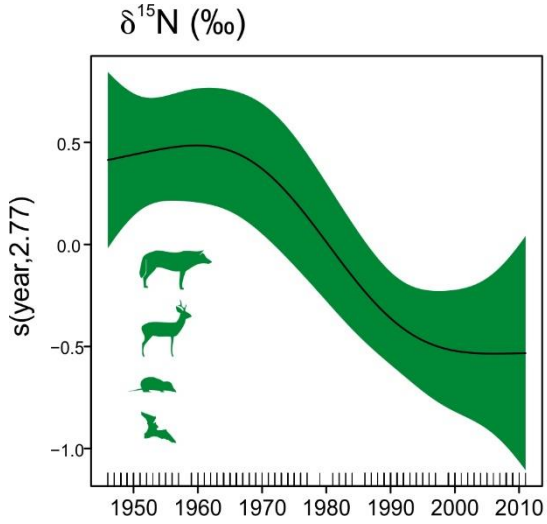

Las complejas interacciones entre los motores de cambio global requieren un monitoreo ecológico con una perspectiva que incluya múltiples especies. El análisis de isótopos estables en tejidos de colecciones de museos brinda oportunidades únicas para estudiar los cambios ambientales en diversas ventanas espaciotemporales. Realizamos un estudio de isótopos estables en pelo de las 50 especies que componen la comunidad de mamíferos del bosque de Białowieża (Polonia) a lo largo de siete décadas (1946-2011). Se e una disminución significativa en la proporción de isótopos de nitrógeno, que fue particularmente notable para los herbívoros. Esta tendencia es consistente con los patrones de deposición antropogénica de nitrógeno y con la oligotrofización a escala global reportada para los ecosistemas forestales como resultado del aumento de [CO_2] y de las temperaturas. Crédito de la foto: Adam Wajrak

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