

## Press release

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### Hidden Organ holds the Key to Evolution Inner ears help trace development of mammals

**An international team of research scientists led by palaeontologists Bastien Mennecart and Loïc Costeur from the Natural History Museum Basel reveal how ruminants have developed over 35 million years to reach their current level of biodiversity. Examinations of the inner ear of around 200 living and extinct species provide impressive evidence of when and at what rate families of ruminants moved away from their shared roots and began to develop independently. Climate and migration patterns led to the mammals' current diversity.**

With the support of the Swiss Natural Science Foundation, data from the inner ear of extinct and living ruminant species has been meticulously collected at the Natural History Museum Basel for eight years. As part of their research, palaeontologists Bastien Mennecart and Loïc Costeur produced high-resolution images of several hundred ruminant skulls. The data and cross-sections collected made it possible to show the internal organs and structures in three-dimensional form and to reconstruct the inner ear. This basic data formed the starting point for the actual question of how evolution of mammals took place over a period of millions of years. The results of this study have now been published in the renowned journal NATURE COMMUNICATIONS.

#### **The inner ear as a witness to evolution**

The organs of hearing and balance have long been known to provide evidence of the evolution of mammals. Individual fossilized inner ears have helped to define the stages of this evolution. Using the inner ears of mammals, it has been possible to show that the spiral cochlea developed this specific shape around 150 million years ago.

The work of Mennecart and Costeur now provides a confirmation that the inner ear witnesses this evolution. New imaging techniques helped them to produce three-dimensional representations of the inner ear and analyse them statistically. The images show that this "object" can replicate the relationship history of animals. For example, the inner ear of an early, long-extinct giraffe can be clearly assigned to a family because its shape differs from that of other ruminant families.

Other organs are less conclusive. In contrast, the inner ear is particularly useful for tracing evolutionary stages and can be used as a basis for better understanding the evolution of mammals over a long time. The scientists were able to show how the shape of the inner ear of ruminants has evolved over a period of 35 million years, mainly due to climatic factors and settlement of new land masses.

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### **Current diversity has deep roots**

It took biodiversity several million years to become what it is today. Research by the team of scientists shows that certain families of ruminants, such as giraffes, were thriving during periods when the climate was warm. I.e., the shape of their inner ear illustrates how the evolution of the family accelerated over millions of years. They prosper in warmer climatic zones and stable environmental conditions. By contrast, other families, such as bovids or cervids, do better in cooler climates. For them, a higher diversity of habitats to live in in times of variable environmental conditions represent an evolutionary advantage.

### **The effects of land bridges**

However, climate wasn't the only reason why ruminants developed into what we know today. Continental build-up plays a complementary role. The cervid, or deer, family are a good example of this: Around three million years ago, a land bridge between the two continents allowed deer to migrate from North America to South America. The consequence of this was that many species were formed within the deer family because the deer settled in the many new niches on the newly available continent and had to adapt to the environment and living conditions there. Rapid and considerable diversification of deer resulted, which is impressively demonstrated by the evolution of the shape of the inner ear. Today, around 19 different deer species live in South America, corresponding to just under half of all known species in the deer family.

### **Duty to protect**

Almost half of all ruminant species are now on the red list of endangered species. The influence of humans on the survival of species is obvious, as clarified by the "Living Planet Report" published by WWF in 2022. This study by the Basel scientists and their team shows that the roots of diversity of today's ruminants go back 35 million years. We now live on our planet with animals that have been evolving for many millions of years. We owe it to our shared history to protect this legacy.

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### **More information**

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