 DOI: 10.24425/academiaPAS.2024.152927

Ancient Ailments in Cave Bears

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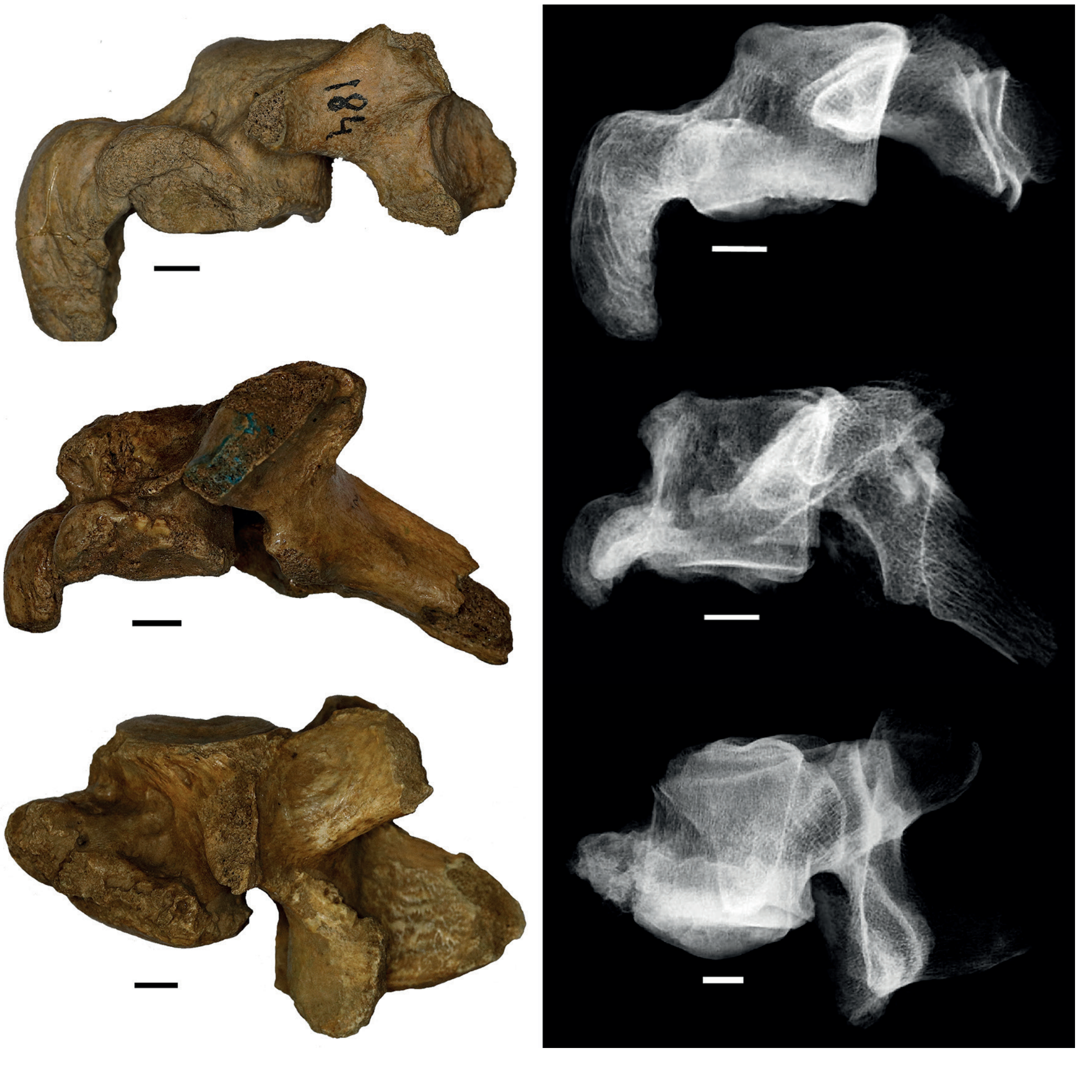
Modern research on fossil material reveals how the cave bears of the Pleistocene suffered from a variety of diseases.



Cave bear vertebrae showing visible bone growth lines when x-rayed (scale: 1 cm)

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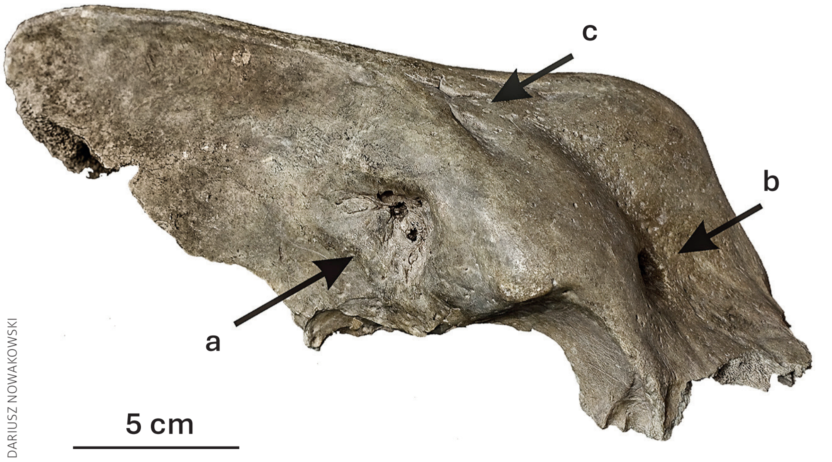
The field of *paleopathology* studies fossil organisms to identify abnormalities in their remains. This includes analyses of the living conditions of these organisms and the causes of their diseases. Researchers often examine bone fragments, entire bones, skeletons, or even mummies. These studies provide insights into the causes, progression, and variability of numerous diseases. Common findings include conditions resulting from injuries, nutritional deficiencies, inflammations, and degenerative-deformative changes in bones, which form a significant category of diseases observed in fossil material. By analyzing pathological changes in fossil remains, we gain not only a deeper understanding of modern health issues in humans and animals but also valuable knowledge about the environments ancient animals once inhabited.

As the science of paleopathology advances, new research methods are being developed, incorporating innovations from fields such as medicine and biology. These advancements allow researchers to document the presence of diseases and investigate the living conditions, causes of death, dietary habits, and climatic environments of the organisms studied. In recent years, cutting-edge medical techniques have been applied to paleopathological research, uncovering information that was previously beyond reach with traditional methods. Alongside international discoveries, Polish scientific literature also documents evidence of traumatic changes identified in fossil material. Notable examples include findings from the site known as Bear Cave in Kletno, Poland, where signs of disease processes have been observed in bear bones.

Pathological changes

The detailed paleopathological research at this site focused on over 1,500 bones and bone fragments belonging to cave bears from Quaternary deposits in Bear Cave. These specimens are currently housed in the collections of the Department of Paleozoology at the University of Wrocław. Several complementary methods were used to analyze the bones, enabling a thorough examination of their structure. Morphological, radiological, and histological analyses were conducted, allowing for a detailed description of both macroscopic and microscopic changes, identification of pathological conditions, determination of the bears' age, analysis of Harris lines, and evaluation of bone tissue defects.



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The cranium of a young female cave bear showing pathologies:
a) trace of an abscess,
b) cut marks from a sharp tool,
c) a puncture wound from a predator bite

The analysis revealed numerous pathological changes, including 22 cases likely caused by trauma. Thirteen cases appeared to be linked to inflammation or rickets-like conditions, consistent with global research indicating that such conditions often result in fractures from relatively minor injuries. Most abnormalities were identified through radiographs, which revealed conditions such as osteoporosis, osteomalacia, and bone loss associated with other diseases. Inflammatory changes made up a significant portion of the diseases identified in the studied population. The analysis of cave bear bone tissue suggests that such inflammatory conditions were relatively common.

> In recent years, modern medical techniques have been incorporated into paleopathological research, enabling insights that were previously unattainable through traditional methods.

In medicine, distinguishing between pathological conditions – such as inflammation, tumors, tumor-like changes, or tuberculosis – can be challenging, and misdiagnoses are not uncommon. Accurate diagnosis often requires additional tests that cannot be performed on fossil material.

The only probable case of tuberculosis identified in the studied material was an ulna, with two additional cases of similar changes observed in vertebrae. These findings suggest tuberculosis may have been present in the Kletno cave bear population.

The studied material also revealed signs of abscesses in five long bones, likely caused by trauma. In severe cases of periosteal inflammation, necrotic areas can develop. Dead bone tissue can irritate sur-

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rounding structures, leading to bone resorption and defects. Such features were observed in one of the examined radial bones.

Among the inflammatory conditions identified in the long bones, those of rheumatoid origin were the most common. Rheumatoid ankylosing spondylitis was also observed in vertebrae, indicating a chronic and debilitating condition often classified as having an unknown cause. In the Kletno population, rheumatologic conditions may have been a significant contributor to mortality. Mobility issues caused by these diseases likely hindered the bears' ability to find food or defend themselves, potentially leading to their deaths. However, it is worth noting that these conditions were not widespread across the studied population.

Rare conditions included bone infarctions, which led to localized necrosis, and periosteal inflammation that progressed to myositis ossificans. In rare instances, myositis ossificans can develop into malignant tumors, such as sarcomas, which may have caused the death of one of the studied bears. Two cases of fibrous dysplasia, a benign bone tumor, were identified, along with a chondroma on one long bone. These conditions likely had little impact on the animals' overall health. Additionally, an osteoma, most likely a spongy osteoma, was found on a tibia, which also appeared to have minimal effect on the bear's wellbeing.

Mineral deficiencies

The presence of 10 cases of rickets suggests that this disease was not incidental among the Kletno cave bear population. Its prevalence may have been linked to certain environmental factors characteristic of the Śnieżnik Massif region in the Pleistocene. Probable causes of rickets include limited calcium absorption and low dietary calcium levels. Radiological analysis of the examined bones revealed signs consistent with the late stages of rickets.

Additionally, at least five cases of changes in long bones were attributed to the aging process. When analyzing abnormalities in fossil material, it is important

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to remember that some changes are natural, physiological effects of aging and should not be mistaken for pathological conditions.

Nevertheless, certain pathological changes noted in the vertebrae of the Kletno specimens represent a significant and intriguing aspect of paleopathology, particularly as they were found in over 21% of the examined vertebrae – a relatively high percentage compared to other analyzed finds. We noted that similar vertebral changes can result from various causes. The analyzed vertebrae showed advanced disease progression, with early stages visible as bony growths around costal joint surfaces, alterations in small joints, and changes in processes. As the disease progressed, the edges of intervertebral surfaces thickened, forming bony projections that could create bridges with neighboring vertebrae, ultimately leading to fusion and stiffening of the spine.

Although osteophytes were present on the joint surfaces of vertebral bodies, visible damage to the compact bone surface was not always evident. However, deviations from normal bone structure, such as sclerosis of the vertebral endplates, were frequently observed and clearly visible in radiographs.

The intervertebral surfaces exhibited a variety of changes, ranging from minor erosions to remnants of Schmorl's nodes and significant bone tissue destruction. In the most severe cases, the intervertebral surfaces were covered with osteophytes and syndesmophytes, which could result in spinal stiffness, reflecting advanced disease. The most common changes included vertebral inflammation and degeneration, such as spondyloarthritis and ankylosing spondylitis. These conditions were identified in over 10% of the studied vertebrae, accounting for about half of the spinal pathologies recorded. This prevalence suggests that these conditions were common in the Pleistocene bear population from this region.

A variety of injuries

Detailed pathological studies on the skull of a young female cave bear revealed a range of injuries that occurred at different points in its life. Longitudinal marks on the skull's vault were attributed to multiple blows with a sharp object. Sclerotic lines visible in radiological and tomographic examinations indicate that the bear survived these injuries. Criminological studies describe similar wounds as resulting from blows with tools that have sharp edges, while archaeological evidence suggests the possible use of a blade during skinning. These scars may have resulted from contact with humans, even though humans and cave bears occupied distinct ecological niches.

Another injury was a hole in the frontal bone, also initially thought to result from a blow. However, the presence of a callus around the scar indicates that the bear survived the trauma, which was more likely caused by a bite from another predator. The most serious injury was found on the right parietal bone, where inflammation and an abscess likely spread toward the meninges, potentially contributing to the bear's death.

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In the study of cave bear bones from Kletno, we also analyzed the potential reasons for the species' decline toward the end of the Pleistocene by examining transverse growth arrest lines in bones, known as *Harris lines*. These lines, characterized by increased bone density, are often used as indicators of stress, reflecting the body's response to adverse environmental conditions, such as periods of famine. Approximately 2,000 intact long bones were analyzed, with Harris lines expected in 392 of them. Radiographs revealed transverse lines in 3.1% of the total bones. Supplementary histological analysis indicated that only a small number of individuals in this population experienced periodic food shortages, primarily during the winter and early spring, much like modern brown bears. These periods of famine, which temporarily slowed growth, mainly affected young bears between their first and fourth years of life. These episodes were likely short and sporadic, having little overall impact on the development and growth of Pleistocene cave bears. The identification of Harris lines in cave bear bones is also the first such finding reported in the global literature.

Understanding the species composition and ecological requirements of bone remains from caves in this region enables the reconstruction of climatic and paleoecological changes in the Śnieżnik Massif over the last several tens of thousands of years. However, the role of disease in shaping the biological condition of cave bears remains an open question. Further research may shed new light on the factors that limited the population of these predators. ■

Further reading:

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