53 million-year-old high Arctic mammals wintered in darkness

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A hippo-like mammal known as Coryphodon was one of several ancient mammal groups that endured twilight winters in the high Arctic 53 million year ago, according to a new study led by the University of Colorado at Boulder. Credit: Image copyright American Museum of Natural History/D. Finnin.

(PhysOrg.com) -- Ancestors of tapirs and ancient cousins of rhinos living above the Arctic Circle 53 million years ago endured six months of darkness each year in a far milder climate than today that featured lush, swampy forests, according to a new study led by the University of Colorado at Boulder.

CU-Boulder Assistant Professor Jaelyn Eberle said the study shows several varieties of prehistoric mammals as heavy as 1,000 pounds each lived on what is today Ellesmere Island near Greenland on a summer diet of flowering plants, deciduous leaves and aquatic vegetation. But in

winter's twilight they apparently switched over to foods like twigs, leaf litter, evergreen needles and fungi, said Eberle, curator of fossil vertebrates at the University of Colorado Museum of Natural History and chief study author.

The study has implications for the dispersal of early mammals across polar land bridges into North America and for modern mammals that likely will begin moving north if Earth's climate continues to warm. A paper on the subject co-authored by Henry Fricke of Colorado College in Colorado Springs and John Humphrey of the Colorado School of Mines in Golden appears in the June issue of *Geology*.

The team used an analysis of carbon and oxygen isotopes extracted from the fossil teeth of three varieties of mammals from Ellesmere Island -- a hippo-like, semi-aquatic creature known as Coryphodon, a second, smaller ancestor of today's tapirs and a third rhino-like mammal known as brontothere. Animal teeth are among the most valuable fossils in the high Arctic because they are extremely hard and better able to survive the harsh freeze-thaw cycles that occur each year, Eberle said.

Telltale isotopic signatures of carbon from enamel layers that form sequentially during tooth eruption allowed the team to pinpoint the types of plant materials consumed by the mammals as they ate their way across the landscape through the seasons, Eberle said.

"We were able to use carbon signatures preserved in the tooth enamel to show that these mammals did not migrate or hibernate," said Eberle. "Instead, they lived in the high Arctic all year long, munching on some unusual things during the dark winter months." The study was funded by the National Science Foundation.

University of Colorado at Boulder Assistant Professor Jaelyn Eberle, left, searches for early mammal fossils in the high Arctic with Brendan Postnikoff of the University of Saskatchewan (blue parka) and Joe Kudlack, right, from Banks Island in the Northwest Territories. Credit: Image courtesy University of Colorado

An analysis of oxygen isotopes from the fossil teeth helped determine seasonal changes in surface drinking water tied to precipitation and temperature, providing additional climate information, said Eberle. The results point to warm, humid summers and mild winters in the high Arctic 53 million years ago, where temperatures probably ranged from just above freezing to near 70 degrees Fahrenheit, Eberle said.

The environment on central Ellesmere Island, located at about 80 degrees north latitude, was part of a much larger circumpolar Arctic region at the time, she said. It probably was similar to swampy cypress forests in the southeast United States today and still contains fossil tree stumps as large as washing machines, Eberle said.

On central Ellesmere Island in today's high Arctic -- a polar desert that features tundra, permafrost, ice sheets, sparse vegetation and a few small mammals -- the temperature ranges from roughly minus 37 degrees F in

winter to 48 degrees F in summer and is the coldest, driest environment on Earth. There is sunlight in the high Arctic between October and February, and the midnight sun is present from mid-April through the end of August.

The year-round presence of mammals such as the hippo-like Coryphodon, tapirs and brontotheres in the high Arctic was a "behavioral prerequisite" for their eventual dispersal across high-latitude land bridges that geologists believe linked Asia and Europe with North America, Eberle said. Their dietary chemical signatures, portly shapes and fossil evidence for babies and juveniles in the Arctic preclude the idea of long, seasonal migrations to escape the winter darkness, she said.

"In order for mammals to have covered the great distances across land bridges that once connected the continents, they would have required the ability to inhabit the High Arctic year-round in proximity to these land bridges," Eberle said.

Instead, the animals likely made their way south from the Arctic in minute increments over millions of years as the climate shifted. "This study may provide the behavioral smoking gun for how modern groups of mammals like ungulates -- ancestors of today's horses and cattle -- and true primates arrived in North America," said Eberle, also an assistant professor in CU-Boulder's geological sciences department.

The surprising menagerie of Arctic creatures during the early Eocene epoch, which lasted from roughly 50 million to 55 million years ago, first became evident in 1975 when a team led by Mary Dawson of the Carnegie Museum of Natural History in Pittsburg discovered fossil alligator jaw bones. Since then, fossils of aquatic turtles, giant tortoises, snakes and even flying lemurs -- one of the earliest forms of primates -- have been found on Ellesmere Island, said Eberle.

The new *Geology* study also foreshadows the impacts of continuing global warming on Arctic plants and animals, Eberle said. Temperatures in the Arctic are rising twice as fast as those at mid-latitudes as greenhouse gases build up in Earth's atmosphere from rising fossil-fuel burning, and air temperatures over Greenland have risen by more than 7 degrees F since 1991, according to climate scientists.

"We are hypothesizing that lower-latitude mammals will migrate north as the temperatures warm in the coming centuries and millennia," she said. If temperatures ever warm enough in the future to rival the Eocene, there is the possibility of new intercontinental migrations by mammals."

Because the oldest known tapir fossils are from the Arctic, there is the possibility that some prehistoric mammals could have evolved in the circumpolar Arctic and then dispersed through Asia, Europe and North America, said Eberle. "We may have to re-think the world of the early Eocene, when all of the Arctic land masses were connected in a supercontinent of sorts," she said.

Source: University of Colorado at Boulder (news : web)