temperatures every 10,500 years.

Some confirmation came last September, when Jeffrey Park of Yale University, D'Hondt, and their colleagues published evidence of a strong double-time climate beat 75 million years ago, from a site in the Atlantic (*Science*, 10 September, p. 1431). But until Hagelberg's work, nobody had found a double time beat in recent climate.

Hagelberg searched for evidence of the double-time cycle in three deep-sea cores of sediment laid down during the past 1 million years in the eastern tropical Pacific, the eastern tropical Atlantic, and the North Atlantic at 50°N. All three cores record climate in the form of the varying amount of carbonate from plankton that lived in the overlying waters. The population of plankton—and hence the amount of carbonate—should vary with climate factors such as the intensity of wind-driven upwelling of deep, nutrient-rich waters. Hagelberg found not only that the carbonate content varied over periods of 10,000 to 12,000 years, but also that much of the periodicity was in step with the precession cycle. At the tropical sites perhaps 50% of the climate variability having periods of 10,000 to 12,000 years was Milankovitch-related, says Hagelberg.

That's a nice confirmation of the model prediction, but the results from the North Atlantic site are perhaps more intriguing. Though the site lies far from the tropics, as much as 30% of the sediment core's 10,000 to 12,000 year variability was still coupled to the double-time precession cycle. Perhaps tropical Milankovitch forcing unsettles mid-latitude weather patterns by influencing heat transport throught the ocean, Hagelberg says. Fill in one blank space on the map, it seems, and another gap is sure to beckon.

–Richard A. Kerr

POPULATION GENETICS

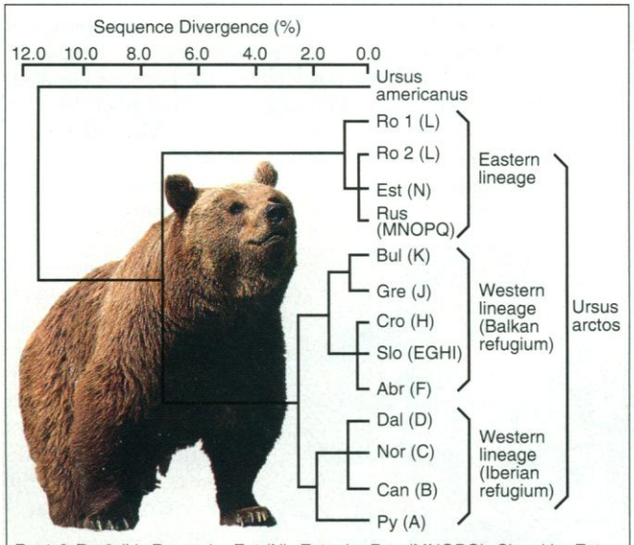
A Family Tree of European Bears

PARIS—The French Ministry of the Environment recently found itself playing matchmaker, desperately looking for consorts with acceptable family backgrounds. Its task: to preserve a population of European brown bears living in the Pyrenees, which has shrunk to just 10 animals and is facing extinction. The obvious solution would be to bring in some bears from other regions, but the imported animals would have to be genetically similar to the threatened bears—otherwise, the mixing could lead to an irretrievable loss of the genetic heritage of the Pyrenean brown bear. Likely candidates would be nearby populations, but the only remaining bears in western Europe are isolated groups in France, Spain, and Italy that total less than 100 animals. So the ministry wondered if members of the large populations of brown bears in Russia and Romania would be genetically acceptable.

To find out, it called in geneticists Pierre Taberlet and Jean Bouvet from the Laboratory of the Biology of High Altitude Populations of the Université Joseph Fourier at Grenoble in the French Alps. Their work has produced a remarkable offshoot: a unique family tree of bears. Taberlet and Bouvet set about their matchmaking by collecting samples of DNA (mostly from hair) from 60 European bears (*Ursus arctos*), from Spain to Russia, and from Greece to Norway. For comparison, they threw in samples from one American black bear (*Ursus americanus*) and DNA extracted from bones of the long-extinct European cave bear.

The researchers compared changes in a variable stretch of the bears' mitochondrial DNA containing 280 base pairs and found a clear-cut difference between eastern European bears and the isolated populations in western Europe: More than 7% of the DNA was different. The American black bear was even further removed, with 12% of the DNA sequence differing from its European cousins. Using the rate for evolutionary change in a homologous sequence of human mitochondrial DNA as a molecular clock, Taberlet and Bouvet estimate that the two European lines diverged about 850,000 years ago during the first ice age.

The western bears were themselves split into two groups when the animals were pushed southward and one branch took refuge in the Iberian peninsula, the other in the Balkans. After the thaw, the populations spread out again but did not mix, and some of the eastern bears crossed the land bridge between Siberia and Alaska into the New World, where they gave rise to the Montana and Rocky Mountain grizzly (an American brown bear, also *U. arctos*). Alaska's Kodiak bear (again *U. arctos*) is thought to have appeared later and this line also spawned the closely related polar bear (*Ursus maritimus*).



Family portrait. *U. arctos* genealogy based on mtDNA analysis.

SOURCE: P. TABERLET AND J. BOUVET PHOTO: PETER NORMAN/ANIMALS ANIMALS

Paleontologist Oliver Ryder of the Center for Reproduction of Endangered Species at the Zoological Society of San Diego says that fossil records confirm the French findings that the brown bear and polar bear have their origins in Europe in the early Pliocene. "The 0.85 million year date is perfectly consistent with the fossil record," he says. But he cautions that bear DNA may mutate at a different rate from human DNA so some correction in the dating may be needed. Ryder adds that his own, unpublished work with mitochondrial DNA suggests that the American black bear did not evolve from the brown bear but from an earlier common ancestor, which explains the 12% difference in their DNA.

The French researchers also acquired some 30,000-year-old bones of cave bears (*Ursus spaeleus*) that were excavated from the Pré-l'Etang cave at the foot of the Alps near Grenoble. The huge 700-kilogram, 3-meter cave bear was a vegetarian that became extinct at the end of the last Ice Age. Catherine Hänni of the Pasteur Institute in Lille, an up-and-coming specialist in ancient DNA, managed to extract and amplify a 140 base-pair fragment of mitochondrial DNA from the bones. Her analyses indicated that the cave bear appeared at about the same time as *U. arctos*, 850,000 years ago. But Ryder warns that the smallness of this fragment could again lead to errors in dating.

Taberlet and Bouvet concluded from their genealogy that eastern bears would not be suitable consorts for their threatened western cousins. The Ministry of the Environment has accepted their advice and it is now assessing bears from nearer to home, such as southern Scandinavia and Bulgaria.

–Alexander Dorozynski

Alexander Dorozynski is a journalist based in Paris.