The skulls of four hundred wolves are suspended before me. An orange backlight reveals their silhouettes aligned in perfect rows, and for a moment, I think of an army of ghosts. I look at them one by one, but they don't stare back from their empty orbits. After a while, the dead wolves disclose some long-gone stories: a broken tooth, a deep scar on the bone, the delicate features of a young one who never became an adult.

The dawn of wolves

I am not describing a bad dream. This actually happened during my last visit to La Brea Tar Pits in Los Angeles. In one of the sections of the La Brea museum, there is a dramatic wall displaying the skulls of 404 individuals of an extinct species known as the dire wolf (*Canis dirus*). These wolves were not the victims of a tragic single incident: they died over a span of many thousands of years. Some of these skulls look like they were on the forest floor only a few years ago, but that's an illusion – the most recent of them are several thousand years old.

The ancient pools of natural asphalt pouring out of the ground at La Brea were often concealed by a layer of leaves and debris that turned them into a deadly trap. Animals who unintentionally walked on these pits found themselves permanently glued to a melting landscape and their remains attracted carnivores and scavengers who also got trapped. The carcasses of these animals eventually sank and the tar preserved their bones in excellent conditions. Millions of bones have been recovered at La Brea, allowing researchers to learn more about prehistoric ecosystems and the animals that once populated them.

When I was a kid, paleontology seemed pretty straightforward: I deduced that in time, dire wolves became our wolves of today in the same fashion saber-toothed cats became our tigers, right? Wrong. I was in for a shocker when later I learned that dire wolves actually shared the landscape with our modern gray wolves (*Canis lupus*). Evolution is not as simple as that ten-year old thought! The ancestry of wolves is a puzzling tale and the blanks on the map have fueled scientific debate for many

years. That's why it's such a fascinating story.

The dire wolf was formidable, similar to our gray wolf but much more robust, with larger teeth, a stronger bite force and proportionally shorter legs – a wolf on steroids! It was a success in its time, to the point of being hailed by researchers as "the most common fossil canid in North America." Studies of inorganic compounds on dire wolves' bones show they fed on animals like horses, mastodons, camels and terrestrial sloths the size of bison. Contrary to some popular misconceptions, bigger and stronger don't necessarily mean survival and the dire wolves became extinct about 10,000 years ago. They were not alone; dozens of species of big-bodied animals known as the prehistoric megafauna disappeared in a planetary event known as the Quaternary Extinction. This collective vanishing act has been explained by a combination of two scenarios: extreme climate changes and excessive hunting by modern humans.

Dire wolves, however, were a rather modern twig in the wolf family tree. The family known as *Canidae* or canids, originated in North America and its story can be traced up to 40 million years ago, to a geologic epoch known as the Eocene. In that era, the polar ice caps were absent and the world was much warmer and humid than today, favoring luxuriant tropical forests in unlikely places like Wyoming and Germany. This is when the family of wolves had a humble start in the form of small creatures no larger than a corgi; since then, the fossil record has yielded more than 200 species of canids, most of them becoming extinct through time, leaving

us with the 37 or so species existing today. There have been wild dogs of all sizes and shapes. A species of the genus *Epicyon* (from the Greek "before dog") that originated about 12 million years ago, was the largest canid we know of and it stood as tall as a small lion; this ferocious looking animal had a strange short-face as an adaptation to increase bite power, allowing it to crack bones and extract the nutritive marrow. There were also less dramatic dogs, like a delicate foxlike species of the genus *Otarocyon* ("large-eared dog"), who might have looked pretty much like our modern fennec foxes of the Saharan desert.

America. The old dogs were about to learn new tricks by traveling.

As canids radiated through Eurasia, they adapted to new habitats, forming a vast arrange of novel species. About 1.8 million years ago, at the beginning of the Pleistocene (aka Ice Age), there was such a melting pot of canids that some refer to this time as the "Wolf Event." Some forms of these ancestral wolves were so similar to each other, that often it's hard to establish which lineage gave origin to whom.

The lower temperatures during the Ice Age also generated drier and more seasonal conditions and the landscape in higher latitudes went

caribou and other megafauna associated with the Arctic regions. Then the gray wolves dispersed through the Old World, reaching the coasts of Northern Africa. Eventually they also crossed Beringia, finding their way towards North America, the original cradle of their dynasty.

So the old dire wolf perished. It is believed that its demise was related to what once allowed it to thrive – specialization. It was too well-adapted to hunt giants and when its prey didn't adapt fast enough to changes, the dire wolf followed them to the end of the line. The gray wolf prevailed instead, and became the most widely distrib-

Most of the evolutionary history of canids happened in North America in relative isolation from the rest of the world. But this changed about 7 or 8 million years ago when the cooling of our world led to the formation of the polar ice caps, while massive glaciers trapped so much water that sea levels dropped hundreds of feet in some shores. This caused the emergence of a massive land bridge in a region known as Beringia (the modern Bering Strait), allowing an intercontinental migration of species and the exploration of new environments. Three million years later the Panama isthmus emerged too, opening the faunal trade with South

from dense forests to vast grasslands. Herbivores had to adapt by increasing their efficiency in consuming grasses and since living in open country exposed them more to predators, they also had to become faster. Canids literally had to keep up, so long legs, large bodies, stamina and coordinated group hunting were adaptations that allowed them tackle fast prey in moving in herds. Put all these ingredients together and you have discovered the universal recipe for wolves.

It is believed that our modern gray wolf (*Canis lupus*) originated somewhere in Eurasia about 800,000 years ago, coexisting with mastodons, bison,

uted species of terrestrial carnivore. The gray's success has to do with its resiliency and legendary capacity to travel, but its longest journey has been through time, witnessing the end of mammoths and the rise of human cities. The elk, the caribou, the conifer forests and the Great Plains wouldn't be what they are without the presence of the wolf. They all shape each other. This evolutionary tale is not meant to end in a museum, because it is far from ending: the story of the wolf is still happening out there, in the living wilderness around us.

– Chris Montero, *Outreach Coordinator*