



# NATIONAL GEOGRAPHIC

LAELAPS *A Blog by Brian Switek*

## The Rise and Fall of America's Fossil Dogs

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When it came time to adopt a dog, I knew I wanted a *dog*. An angry, yappy gremlin wouldn't do. I was on the lookout for a companion that at least somewhat resembled the gray wolf stock from which our domesticated canine companions descended. A real canid. Jet, a black German shepherd I took in earlier this summer, met that description perfectly.

But while I appreciate that Jet has a bit of ancient wolfishness about him, he's not anything like the earliest dogs. Those dawn canids, which split from their cat cousins around 50 million years ago, were more weasel-like than any modern pooch. These

were little ambush predators with dexterous forelimbs that let them grapple with prey. Wolves and other canids as we know them today – pursuit predators that use teeth, rather than paws, to catch and dispatch their victims – are relatively new creatures, and the last remaining sliver of what was once a wider array of prehistoric dogs.

A pair of papers published this month by two different teams of researchers tell the tale. The latest, published today by Universidad de Málaga's Borja Figueirido and colleagues, tracks how prehistoric dogs changed as forests gave way to grasslands.

Prior to 40 million years ago, much of North America would have been unrecognizable. Places that host prairies and deserts today were clothed in thick, humid forests where lemur-like primates and little, multi-toed horses browsed on soft leaves. By about 37 million years ago, though, these forests were ceding ground to grasslands.

Herbivores track the change. Some, like the forest-bound primates, went extinct, while the horses, rhinos, and other plant-chewers evolved higher-crowned molars better suited to grinding, grinding, grinding the tougher grasses. And while it was previously thought that this major ecological shift had relatively little effect on North America's large carnivores, the new study by Figueirido and coauthors concludes that dogs actually went through some dramatic changes as grasslands carpeted the continent.

There were three major lineages of North American dogs during the past 40 million years. There were the early, weaselish hesperocyonines, the bone-crushing borophagines, and the more familiar, wolfish canines. And by looking at the elbow joints of species in all three groups, Figueirido and colleagues were able to reconstruct when canids evolved distinct hunting methods over time.

The hesperocyonines, for the most part, were ambush predators. They could easily turn their paws upwards and had arm flexibility similar to cats. But by around 27 million years ago, when grasslands had become widespread, the borophagines

started doing something different. Their elbow joints, Figueirido and co-authors report, were more similar to “pounce-pursuit” predators – similar to modern foxes. Being able to run out in the open was becoming more important as the receding cover gave ambush predators less space to hide. And, speaking of the vulpine canids, the same pounce-pursuit method apparently evolved again around 7 million years ago around the last common ancestor of foxes and wolves. It wasn’t until the Pleistocene, around 2 million years ago, that the first full-on pursuit canids evolved. These dogs, including the predecessors of wolves, were endurance runners with elbows that primarily permitted a forward-back range of motion. As prey wandered out into the open, canids evolved into predators that could go the distance.





The skull of the small dog *Archaeocyon pavidus* compared to the large *Epicyon haydeni*. © AMNH/J. Tseng.

But dogs couldn't stay on top forever. A second study, published earlier this month by University of Gothenburg paleontologist Daniele Silvestro and colleagues, found that competition between carnivores eventually drove two of the three dog lineages extinct.

Why some groups of organisms prosper and others are totally obliterated is the sort of mystery that keeps paleontologists up at night. Why, for example, were dinosaurs winnowed down to only the birds while mammals were better-able to resist the mass extinction of 66 million years ago and proliferate? This is still unknown. Yet, even if we can't always get a handle on why balances tip this way or that, researchers can still track how rates of speciation and extinction have altered the course of life. The record of North America's dogs offered one such opportunity.

In addition to the hesperocyonines, borophagines, and canines, Silvestro and coauthors investigated the speciation and extinction records for cats, nimravids (false sabercats), barbourofelids (another false sabercat lineage), amphicyonids (bear

dogs), and bears over the last 40 million years. All of these included large carnivores that jostled for space and prey with the canids. By looking at how these different groups fared, the paleontologists picked up patterns that can be explained by groups outdoing each other.

Some of the competition was between the dogs. Between 20 and 10 million years ago, for example, the archaic hesperocyonines suffered a high extinction rate just as the borophagine dogs were undergoing an expansion in their range of body sizes. They were infiltrating the predatory niche the hesperocyonines had controlled for millions of years. This, Silvestro and coauthors write, is a sign of what's called active displacement – one lineage shouldering out another. The telltale clue is that once the more archaic dogs were gone, the borophagines didn't undergo a major radiation (as would be expected if they were somehow being suppressed under “passive displacement” by their competition).

But the borophagines eventually went extinct, too, and competition with a wider array of predators may be the reason why. The borophagines had an intermediate, pounce-pursuit joint structure and many were hypercarnivorous, subsisting almost wholly on flesh and bone. This put them in direct competition with the more dexterous cats who jumped from the tall grass as well as the marathon-running canines. Borophagines may have wound up in the middle of two guilds of predators that had specialized on the ambush and pursuit modes of taking down prey, respectively, leaving the borophagines in the generalist valley between them. Their extinction rate outpaced the rate at which they spun off new species, leaving the running to the canines and the stalking to the felids. Think about that the next time you throw a ball for your puppy or dangle a toy mouse in front of your housecat. The way they play – which is itself predatory practice – is a faint, compact glimmer of 40 million years of extinction and evolution.

## References:

Figueirido, B., Martin-Serra, A., Tseng, Z., Janis, C. 2015. Habitat changes and changing predatory habits in North American fossil canids. *Nature Communications*. doi: 10.1038/ncomms8976

Silvestro, D., Antonelli, A., Salamin, N., Quental, T. 2015. The role of clade competition in the diversification of North American canids. *PNAS*. doi: 10.1073/pnas.1502803112