

L.A.'s Oldest Tourist Trap

At Rancho La Brea, death has been the pits for millennia

Sid Perkins, Science News Online

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Cruise Los Angeles' Wilshire Boulevard and, when you reach the 5800 block, you'll often catch a whiff of fresh tar. Most likely, it won't be coming from a road or roofing crew, but you'll have a big clue to its source. On the north side of the boulevard, there's a life-size fiberglass model of a terrified mammoth stuck hip-deep in goo. The figure marks one of the world's most well-known fossil-bearing locales: the La Brea tar pits. "I certainly know when I've reached work each morning," says John Harris, a curator at the George C. Page Museum there.

This 57,000-square-foot facility houses the millions of bones unearthed at the site. Most of those bones, which began accumulating in the tar pits about 44,000 years ago, were exhumed early in the 1900s, says Harris. Following a half-century hiatus in collecting, due in part to a backlog of specimens and changing museum priorities, scientists in 1969 began more-thorough excavations at one of the park's sites.

Data from those more-modern digs are yielding a wealth of information about the region's ecosystems during recent ice ages and interglacial periods. A simple tally of which body parts have been preserved in the tar-laced sediments is shedding light on prehistoric food chains. Also, sophisticated chemical analyses of the bones themselves are yielding surprising details about how the animals succumbed to the pits and what happened to them in their final, wrenching hours.

Sticky spot

In the late 1800s, Rancho La Brea—literally, the tar ranch—lay about 11 kilometers west of downtown Los Angeles. Between 1870 and 1890, the Hancock family, which owned the 4,400-acre ranch, mined the pits for asphalt and tar, which has long been used as a sealant. The occasional discovery of bones, at first thought to be those of unfortunate cows from the ranch, caught the attention of paleontologists who began excavating the pits in the early 1900s.

Between 1913 and 1915, work at more than 100 pits—some hidden beneath shallow ponds—yielded more than 1 million bones from animals such as mastodons, mammoths, North American lions, and saber-toothed cats. In 1924, businessman G. Allan Hancock donated to Los Angeles County the 23-acre plot that contained most of the tar seeps. Excavations at the park that bears Hancock's name continued into the mid-1920s.

In those excavations, paleontologists used techniques that are crude by today's standards, says Har-



STATELY CAT. Some of the most common and most distinctive fossils unearthed at the La Brea tar pits are those of the saber-toothed cat, a lion-size predator that California has dubbed its state fossil.
Tony Leech/Page Museum

ris. For one thing, he notes, the bone hunters preferred large, complete bones, but often didn't collect information about the position and orientation of those bones within sediments. In many cases, those paleontologists ignored the remains of small vertebrates and invertebrates.

In 1969, when scientists resumed digging at the site specified as Pit 91, they began rinsing the gunky tar from the excavated soil and looking carefully at what was left. More than 40,000 specimens unearthed at Pit 91 between 1969 and 1980 have been identified and cataloged in an electronic database. Of those remains, 18,498 items—nearly half of the entire take—are individual bones of mammals that weighed more than 5 kilograms. This cache of bones has enabled Harris and his colleagues to reconstruct the burial process at La Brea. Harris, Blaire Van Valkenburgh of the University of California, Los Angeles, and Lillian M. Spencer of the University of Colorado in Denver describe that process in the Winter 2003 *Paleobiology*.

More than 95 percent of the mammal bones that the researchers studied came from just seven species. Three were herbivores—the western horse, the ancient bison, and the 2-meter-tall Harlan's ground sloth—and four were predators—the dire wolf, the saber-toothed cat, the North American lion, and the coyote. Except for the coyote, all these herbivores and predators are now extinct. In a result that counters intuition, bones of predators were almost seven times as common in Pit 91 as were those of prey. Overall, an estimated 80 percent of the mammals were carnivores, and 60 percent of the birds were birds of prey. That's a surprise, says Harris, since the number of herbivores in a stable ecosystem always outnumbers the predators by a wide margin.

The disparity arises because the tar pits acted as predator traps, says Van Valkenburgh. After an herbivore stumbled into sticky asphalt, which may have been masked by shallow water or leaves, its struggles attracted meat eaters. Each herbivore entrapment probably triggered a feeding frenzy that resulted in up to a dozen predators being trapped as well, says Van Valkenburgh.

Bone census

The La Brea tar pits probably formed during the last set of ice ages, when petroleum seeped to Earth's surface through fractured rock. Kerosene and the rest of the organic mixture's lighter components evaporated, leaving behind the heavier molecules that make up tar and asphalt. In cool weather, the tar-infiltrated ground was firm enough that even moderate-size animals could walk across it. However, warm conditions caused the tar to ooze from the ground and spread, spelling trouble for everyone, says Harris. Even a gooey layer of tar and asphalt only 4 centimeters thick can immobilize an animal the size of a cow, he notes.

Although La Brea's tar pits have swallowed many thousands of large mammals, countless more steered clear. For example, the fossils represent only one large herbivore trapped each decade or so. One of the most conspicuous findings from a census of bones is the near absence of complete skeletons. By examining the types and ratios of bones that were preserved for each species, however, Harris and his coworkers have been piecing together a description of how the animals died and how their carcasses were subsequently scavenged.

Of the seven mammal species that the team analyzed from Pit 91, skulls and jawbones were collected most often. Only half as many limb bones were recovered as would be expected from the number of heads retrieved. That proportion suggests that the trapped animals fell on their sides as

they became exhausted after failing to escape the tar. Then, carnivores ripped limbs from the upward-facing side of the animals' torsos, says Van Valkenburgh. The other limbs, which were either too tightly stuck in the asphalt to be pulled free or too tar-tainted to be tasty, were left behind to sink into the mire—and become available to modern scientists.



Even carnivores became sitting ducks; the predators' limb bones don't show up in the pits in the proportions expected if their carcasses had escaped scavengers. Dire wolves, an ice age predator larger than today's gray wolf, appear to have been scavenged less often than the saber-toothed cats. However, the large numbers of missing bones among any of La Brea's meat eaters is surprising, says Van Valkenburgh. Modern carnivores rarely feed on other large carnivores, even when carcasses are available, she notes.

DIGGING GOO. Each summer's excavations in La Brea's Pit 91 yield about a thousand large bones and more than 50 buckets of tar-laced sediment chock-full of smaller fossils such as rodents or snails.
Page Museum

Among the large herbivores trapped in the pits, bison were apparently scavenged more thoroughly than horses were. It's possible that they were favored menu items because their bones have larger amounts of nourishing marrow, says Van Valkenburgh. The thicker bones of the horses would also have been tougher to crack open.

Several characteristics of the fossil bones suggest that the remains of trapped animals sank quickly into the tar, the researchers note. First, 93 percent of the bones show no sign of exposure to the weather. Almost half of the specimens show little or none of the outer-surface abrasion that indicates, for example, the scouring action of sediments. Finally, only 2 percent of the bones show any evidence that they had been gnawed or chewed by scavengers.

What's for dinner?

Bone tallies provide general outlines of the carnage occurring in the tar pits. Using sophisticated chemical analyses, scientists have been chronicling some of the gory details. In particular, the respective ratios of carbon isotopes and nitrogen isotopes in bones excavated from the tar pits shed light on dietary habits of the very animal from which the bone derived. By looking at the isotope ratios at different periods, researchers can identify long-term changes in the ecosystem.

Doing those sorts of analyses on La Brea fossils is more difficult than doing them on other recent fossils because the carbon-containing tar has permeated the bones, says Paul L. Koch, a paleontologist at the University of California, Santa Cruz. Even so, he and his colleagues have managed to analyze the bones of dire wolves and saber-toothed cats that were trapped at La Brea at three different times: 30,000 years ago, 15,000 years ago, and 11,000 years ago.

The ratios of carbon isotopes and nitrogen isotopes in saber-toothed cat bones suggest that the species had fairly consistent eating habits during the 20,000 years spanned by these three dates. The specific ratios that Koch and his team found suggest that the cats were eating bison during the first 15,000 years of the period. However, nitrogen-isotope ratios were more variable in the latest sample, possibly reflecting the addition of other prey between 15,000 and 11,000 years ago.

The bones of dire wolves had average nitrogen-isotope ratios similar to those of the saber-toothed cats. The ratios were more variable, however. That suggests the wolves had a more diverse diet than did the big cats, probably a result of scavenging rather than hunting specific prey.

The carbon-isotope ratios found in the bones of dire wolves that lived 30,000 and 15,000 years ago have proved mysterious because they can't be explained by the consumption of herbivores, such as bison, horses, and turkeys, known to be living in the La Brea ecosystem at that time.

The researchers suggest that the dire wolves' mystery meat came from marine mammals. The Pacific coast isn't far from La Brea, says Koch. During periods when food was scarce, the wolves probably foraged over a wide region, including coastal areas where predators could hunt young seals in rookeries or scavenge beached carcasses. Pit-trapped eagles, which had eaten ocean fish, showed elevated isotope ratios similar to those of the dire wolves. The researchers presented results of their analyses last October at the Society of Vertebrate Paleontology in St. Paul, Minn.

Still trapping

Since excavations began at La Brea more than a century ago, the remains of more than 650 species, including at least 60 mammal species, 140 types of plants, 120 varieties of insects, and 60 species of snails and other mollusks have been yanked from the tar-laden sediments. In addition to the remains of extinct creatures, such as dwarf pronghorn antelopes, short-faced bears, ground sloths, and the North American versions of lions and camels, scientists have identified remnants from every mammal species that lives in the Los Angeles Basin today—with the curious exception of opossums, says Harris.

Although the tar pits trapped most of their victims between 44,000 years and 4,000 years ago, they're still a danger for the unwitting creature. Just last Thanksgiving, a flock of about 60 cedar waxwing songbirds got stuck in one of Hancock Park's asphalt seeps.

Paleontologists still conduct excavations at Pit 91, but they now dig only a couple of months per year. In that period, the researchers unearth about a thousand bones and haul up 50 or more 5-gallon buckets of tar-laden sand and soil. All of that gunk has to be rinsed with solvents to remove the tar and then painstakingly sorted so the investigators can identify and catalog the fossils therein. Alas, this year's haul will have to wait, says Harris. There's a backlog of at least 2,000 buckets of sediment in one of the museum's storerooms.

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John M. Harris

George C. Page Museum of La Brea Discoveries

5801 Wilshire Boulevard

Los Angeles, CA 90036

Paul L. Koch

University of California, Santa Cruz

Department of Earth Sciences

Earth and Marine Sciences Building

Santa Cruz, CA 95064

Blaire Van Valkenburgh

Department of Organismic Biology, Ecology, and Evolution

621 Young Drive, South

University of California, Los Angeles

Los Angeles, CA 90095-1606

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