McKittrick Collection at UCMP

Canus dirus skull fossils organized in trays in the UCMP collections.Illustration of jumbled *Canis dirus* fossil bones used in Fossil Find activity.

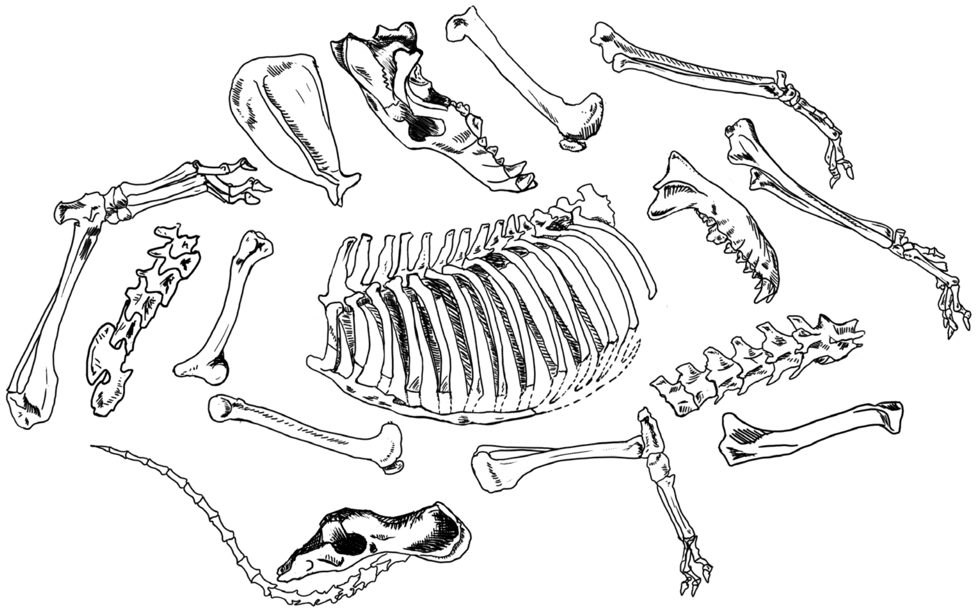


Table of Contents

The University of California Museum of Paleontology recieved funding from IMLS to catalog our collection of fossils found in the tar seeps of McKittrick, CA.

This eBook is companion to our web resouce:

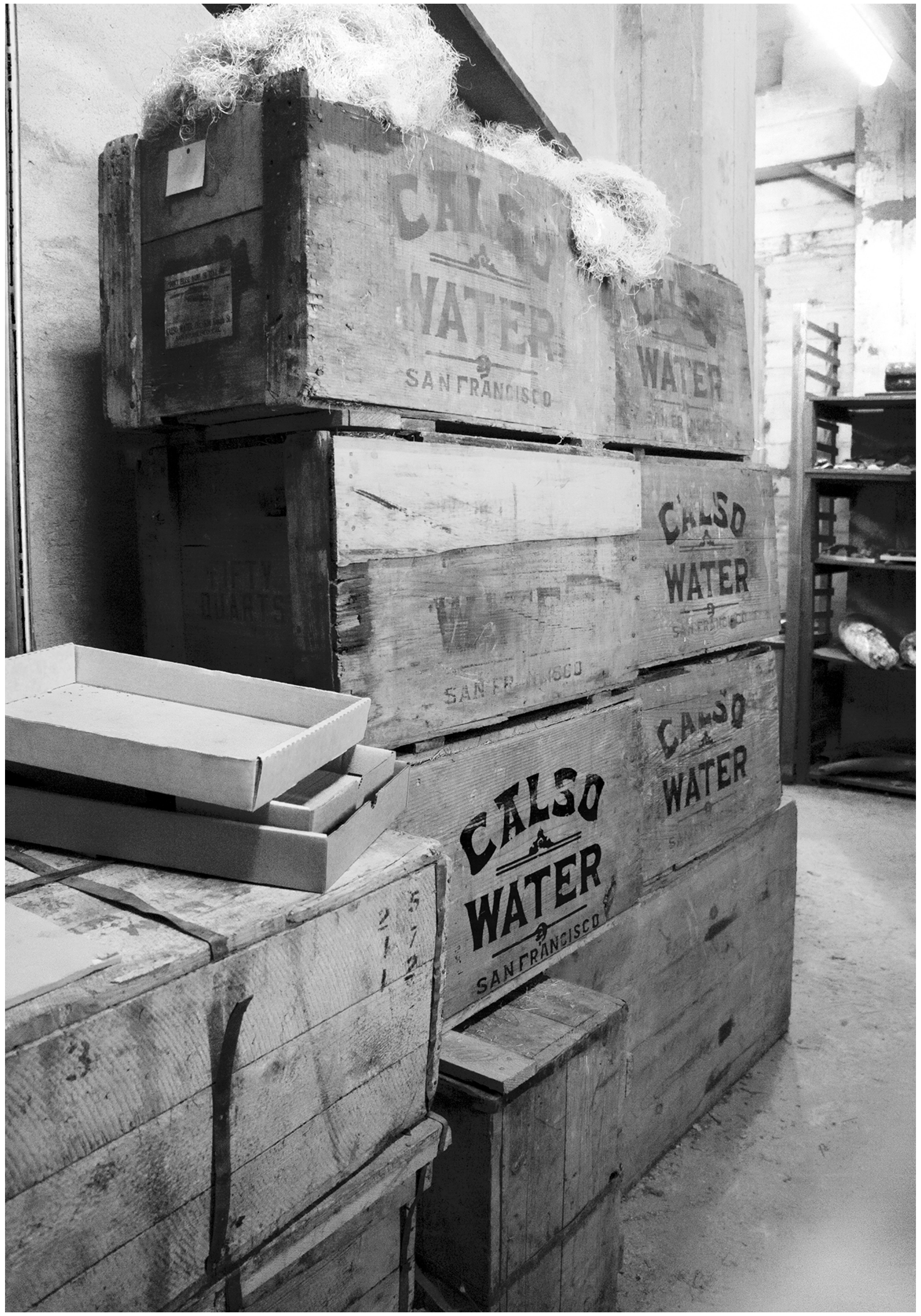
https://mckittrick.berkeley.edu/

History of McKittrick Site

Fossils in the Campanile

Some of the bones collected in the 1930s from asphalt deposits in McKittrick (about halfway between San Luis Obispo and Bakersfield) currently reside in the Campanile, the iconic clock tower on the campus of UC Berkeley.

And back in September we announced the grant award from the Institute of Museum and Library Services to curate the Campanile's McKittrick fossils. To date, more than 2,500 specimens have been cleaned and cataloged, and more than 500 images of 273 specimens have been added to CalPhoto.



From left to right: Illustrations of California's endemic Tule Elk (*Cervus canadensis nannodes*) that could be present at McKittrick. The Campanile, or Sather Tower on UC Berkeley campus, where some of the McKittrick fossils are stored.. Wooden crates stacked up inside the storage areas of the Campanile.

History of McKittrick Site

Collection of fossils

Construction of Highway 33 between Taft and McKittrick led to the discovery of fossils in the tar sands just outside of town. First announced to the world in a 1921 Science paper, most of the digging took place from 1921 to 1927. University of California crews dug the first pits. In 1925 Charles Sternberg moved to a cabin on-site and lived and worked there for two years.

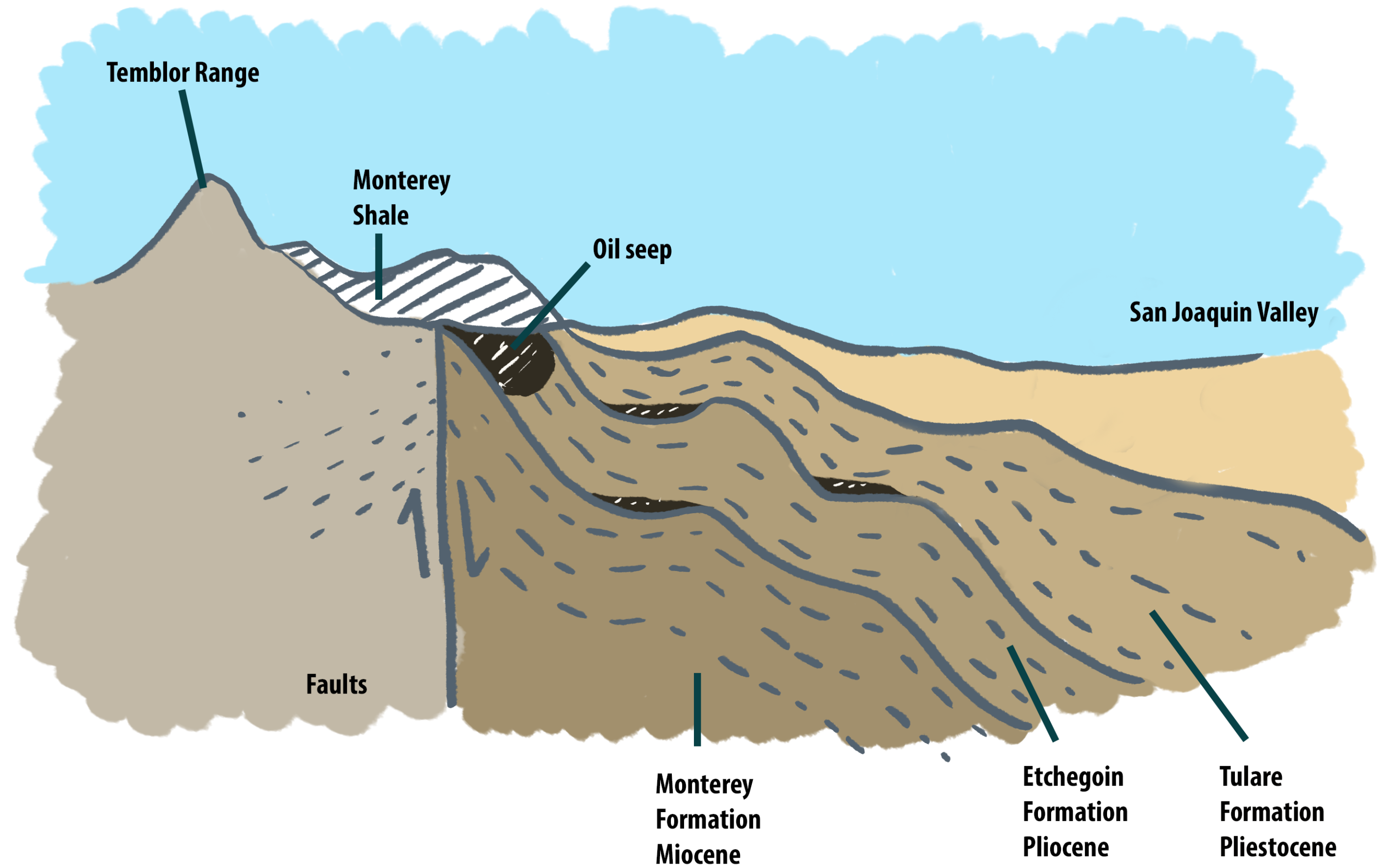
Thousands of fossils were dug out of the tar, using picks, chisels and shovels. They cleaned the bones with petroleum distillate and then carefully brushed the tar away. Then they preserved the bone with a coating of shellac. The fossils were then packed and shipped to the museum.

Several different pits were dug, and the fossils from the different pits vary in age. Using modern radio-carbon methods, we know some bones are as old as 26,850 years before present and some are as young as 11,160 years before present.

Top left: Current day McKittrick road cut. Top right: Geologists examining a roadcut for fossiliferous materials. On the bottom right, the small house in the background is where Charles and Anna Sternberg lived while processing and preparing the McKittrick fossils.

Geology of Tar Seeps

Located in western Kern County, California at the southern edge of the San Joaquin Valley where it meets the Temblor Range, the McKittrick seep site is underlain by Monterey Formation. The Monterey Formation was deposited 17 million to 5 million years ago during the Miocene Epoch and when a large area inland sea covered the Central Valley of California. It contains a high concentration of fossils, primarily diatoms and other marine siliceous microfossils.



Cutaway illustration of the layering of geological formations that are present at the McKittrick Site

The abundance of marine life fossilized in the Monterey Formation results in it being organic-rich, and responsible for much of California's production of oil. Over millions of years, unicellular sea organisms called diatoms died, falling to the bottom of the seafloor and forming diatomite, a rock completely made of diatoms. Due to heat and pressure, the organic material of diatoms was formed into crude oil. This oil is trapped in a shale and today the McKittrick Oil Field in California is surrounded by multiple oil wells and petroleum extraction is the main source of industry in this hot and arid area.

Similar to McKittrick, another similarly oil rich area nearby is called Kettleman Hills. The UCMP has created a Virtual Field Experience around Kettleman Hills that can be visited online at Kettleman Hills VFEs: https://epiccvfe.berkeley.edu/kettleman-hills.

The tar seep sites are located just southwest of McKittrick proper, and are 5 miles in length. The tar forms a continuous string of tar seeps that may or may not be all active at the same time and so coalescence of the oil migrating to the surface occurs over time. Old tar seeps have been observed to become active again, supporting this theory of oil seeping through the surface over a period of time, in a multitude of separate events.

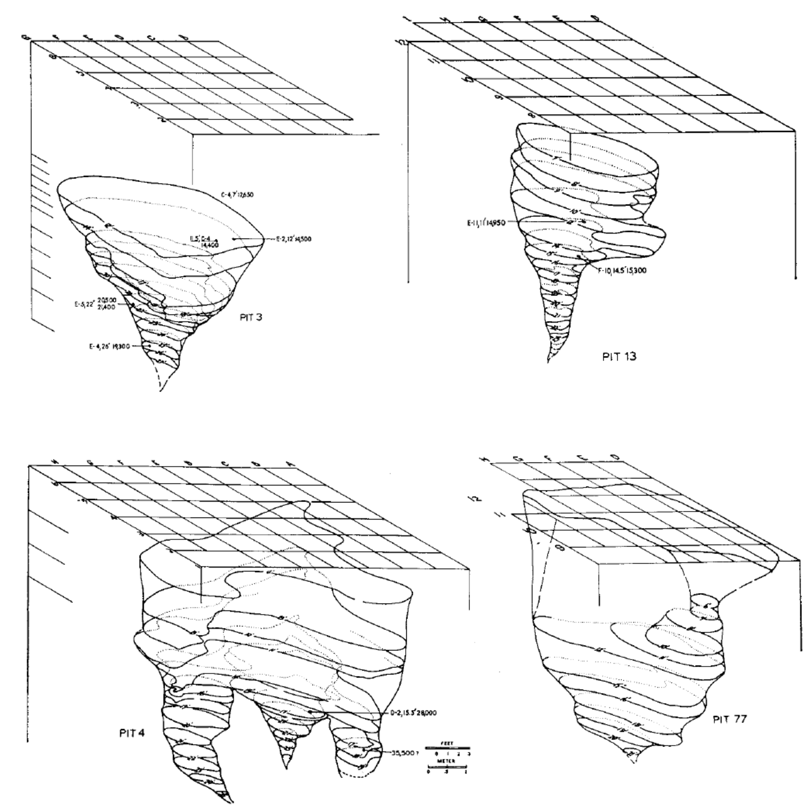
Although referred to as a 'tar' seep, it is not actually tar seeping out on the surface but asphalt. As the oil reaches the surface of the Earth, lighter components such as kerosene evaporate, leaving asphalt, the lowest form of crude oil. Moving through the earth, mixing with clay and sand along the way, results in the thick and stiff material found at tar seeps. During summer, the high heat of the area causes the oil to lose some of its viscosity and run more freely.

How did the fossils get there?

Left: a lantern slide of a top down view inside of a tar pit in La Brea. Right: bone fragment in tar.

Tar Seeps vs. Tar Pits

When people think of the words "fossil" and "tar", most people imagine the La Brea tar pits, where the tar forms a thick pool of liquid rising up from a fissure in the ground. There both large and small animals became stuck and later die of starvation or exposure. Over days or weeks, the carcass becomes submerged. Once submerged, the oil ensured the preservation of the bones, leaving them for paleontologists to find. Tar seeps also follow fissures from ground faulting but are generally smaller in size and may spread on the surface rather than forming pits. Less sticky and gooey, entrapment was likely rarer at these tar seeps.Instead, it is probable the animals found in the tar seep actually perished somewhere else, and ended up in the tar due to flooding or some other kind of displacement. The differences between how the La Brea tar pit and McKittrick tar seep are formed even have an impact on what types of animals are found in the tar.



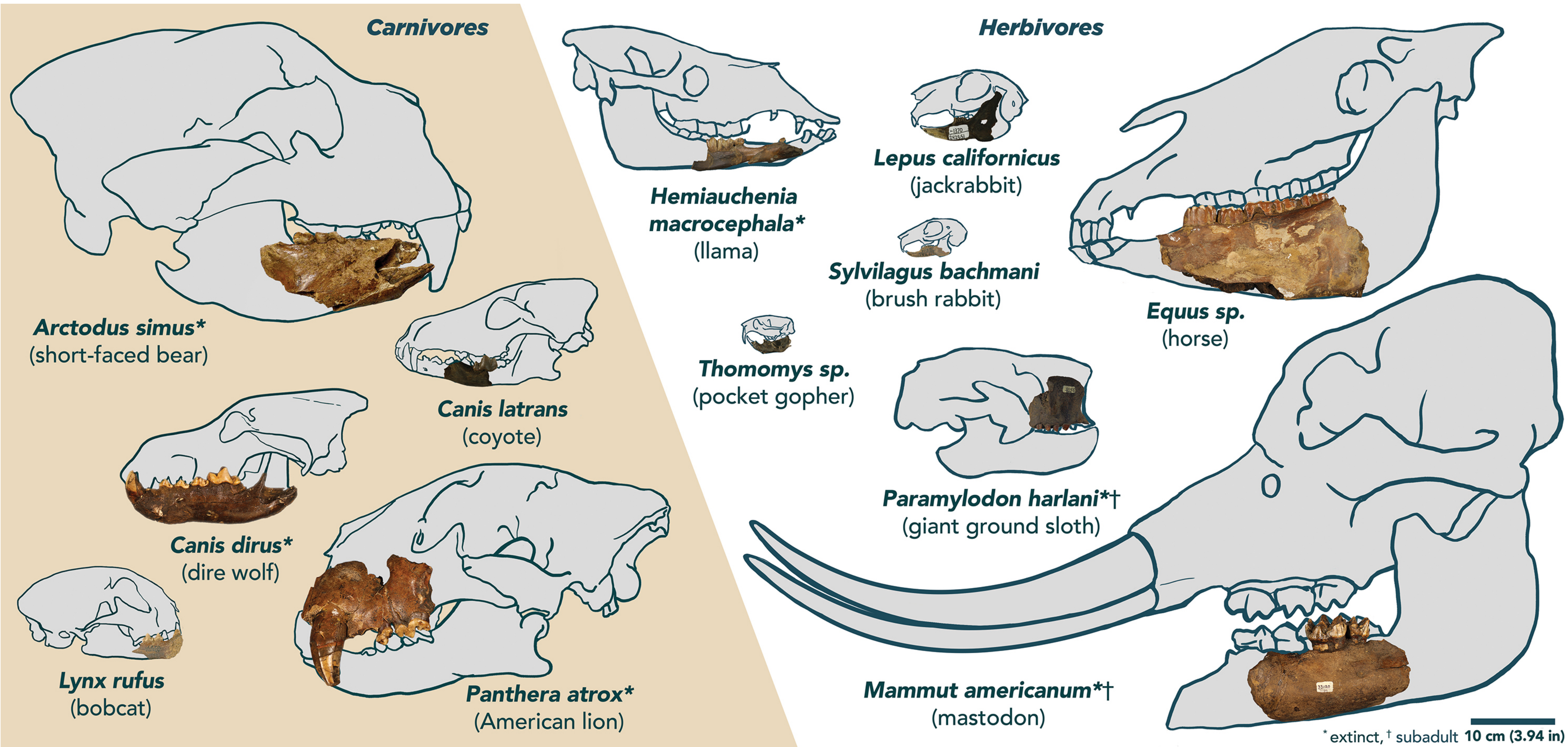
TEXT-FIG. 5—Isometric reconstructions of Pits 3, 4, 13, and 77, based on data of Wyman (1915). Radiocarbon dates from Los Angeles County Museum specimens analyzed by Berger and Libby (1968).

Woodard & Marcus, 1973

Fossil Specimen Comparison

Fossil Skull Comparisons

Of the fossils found at McKittrick, we have a good representation (or highest diversity of skulls). The graphic above shows the size differences among the animals that lived in that ecosystem.



Fossil Specimen Comparisons

More than 29,000 vertebrate fossils were recovered from the McKittrick tar seeps and brought back to Berkeley, ranging in size from the largest megafauna like sloths and elephant-relatives to the smallest birds, lizards, and mice. Study of these fossils allows us to understand the diversity of ancient life in the southern San Joaquin Valley and how dramatically it differs from the area today. Digitization of the collections allow selected images of the fossils below to be uploaded and shared via CalPhotos – a database of photos featuring images of specimens from the UCMP and the rest of the Berkeley Natural History Museums.

In the two images above, the left shows a comparison of vertebrate humeri found at the site. from left to right: *Canus dirus* (dire wolf), *Aquila chrysaetos* (golden eagle), *Smilodon* (sabertooth cat), *Equus* (horse), and *Arctodus simus* (short-faced bear) The image on the right compares femurs from *Equus* and giant sloth.

There are also a few insect fossils that were preserved as well: *Aphonopelma* on the left, a beetle on the right.

Fossil Images

Fossils featured in this booklet can be found online at CalPhotos (https://calphotos.berkeley.edu)

Arctodus simus
(short-faced bear)

Canis latrans
(coyote)

Canis dirus
(dire wolf)

Panthera atrox
(American lion)

Lynx rufus
(bobcat)

Hemiauchenia macrocephala
(llama)

Lepus californicus
(jackrabbit)

Sylvilagus bachmani
(brush rabbit)

Thomomys sp.
(pocket gopher)

Paramylodon harlani
(giant ground sloth)

Equus sp.
(horse)

Mammut americanum
(mastodon)

Food Web and Biotic Interactions

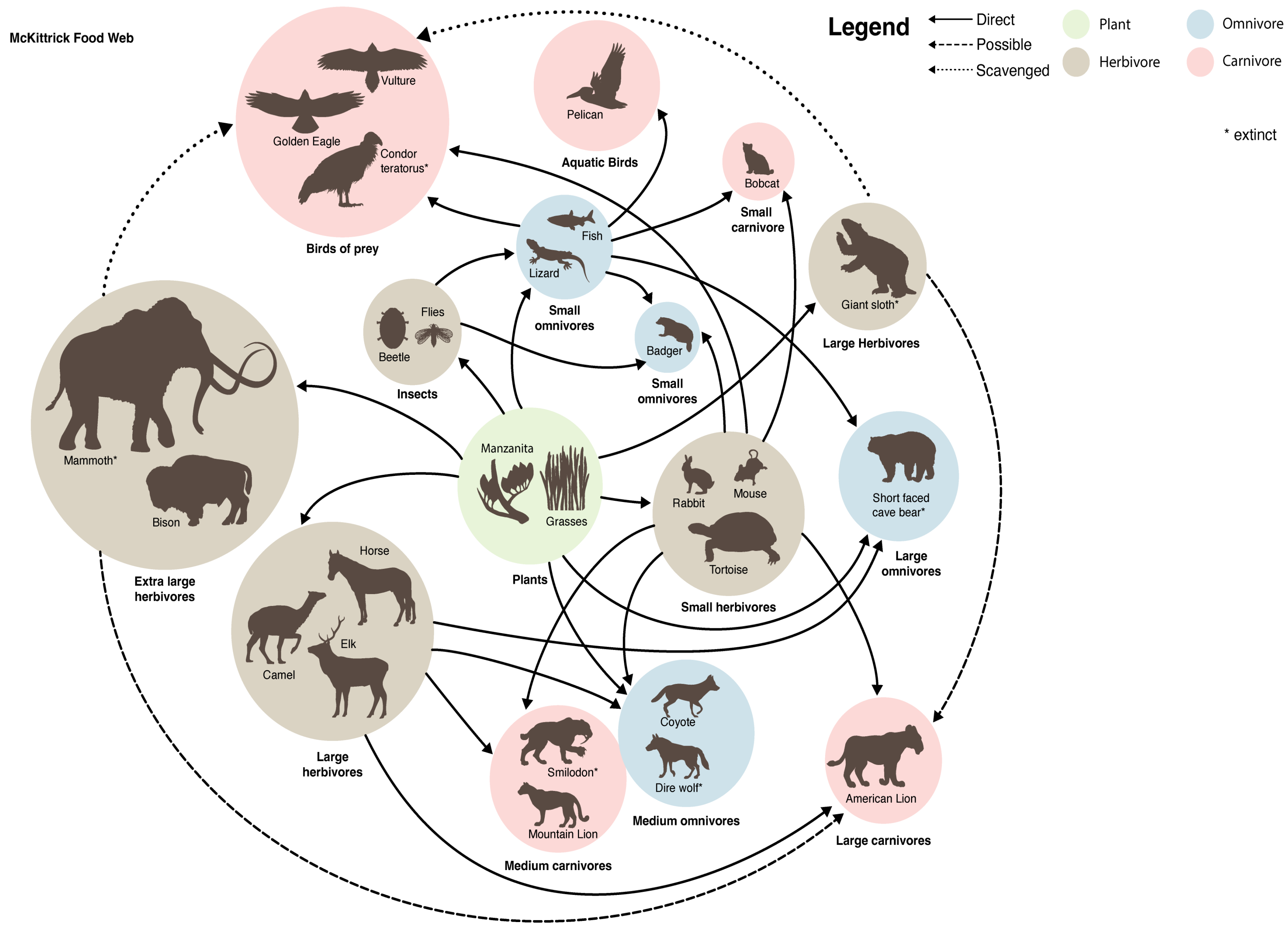
Biotic Interactions

What-eats-what in an ecological community is a great question for any learning level and the charismatic animals of the Pleistocene, including Smilodon, will help to enrich the user experience in understanding how these animals lived. Guiding questions and supporting activities will facilitate understanding concepts related to biotic interactions including:

- Species interactions and species ranges,
- Diversification, evolution, and extinction in communities of organisms,
- Climate and environmental change, and habitat loss in the Pleistocene ecosystems of Central California

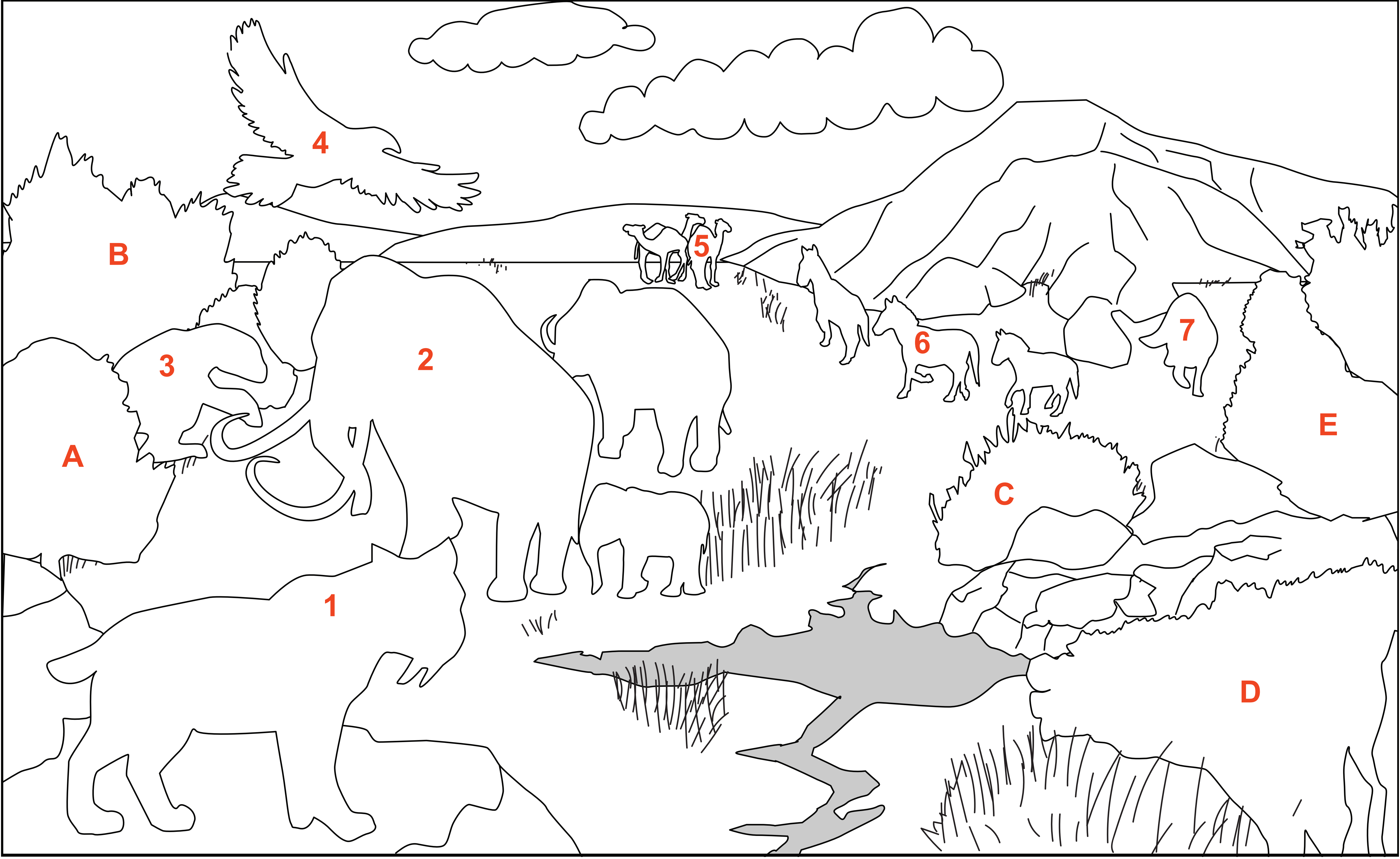
Food webs of the Pleistocene

Food webs are a graphically-rich means of showing the natural interconnections of organisms in a community ecosystem populated by predators and prey. Drawing from the unique suite of McKittrick fossils, the modules will have reconstructed food webs guiding users to information on individual animals, their positions in the food web, and illustrations on feeding pathways. The individual examples of herbivores, carnivores, omnivores, and scavengers will help bring to life the complex relationships in this Pleistocene terrestrial ecosystem. In general, communities of organisms preserved in tar pits are unusual in accumulating more predators than prey. Part of this may be related to entrapment of herbivores.



Visit the mckittrick.berkeley.edu website to see an interactive version of the food web

The reconstruction above shows the possible paleoecology of McKittrick the Pleistocene. The animals depicted in this scene do have long-ranges but there’s a high chance they co-occured there. However, the geologic history of California is very complex and more in-depth information can be found on the History and Geology section.



Fauna:(1) Smilodon, (2) Mammoth, (3) Ground sloth, (4) Golden eagle, (5) Camel, (6) Horse, (7) Dire wolf

Flora: (A) Pine, (B) Juniper, (C) Salt bush, (D) Manzanita, (E) Pine

Scientific Studies

The content and exercises on this site drew on the many scientific papers and popular articles written about the McKittrick site since fossils were first found there. If you want to learn more about the site and fossils, these articles are the primary data. Links are provided for those available online for free.

Written for general audiences

ElShafie, S. 2015. Bones in the Bell Tower. Berkeley Science Review

http://berkeleysciencereview.com/article/bones-bell-tower/

Merriam, J. C., and C. Stock. 1921. Occurrence of Pleistocene vertebrates in an asphalt deposit near McKittrick, California. Science 54:566–567. https://science.sciencemag.org/content/54/1406/566.long

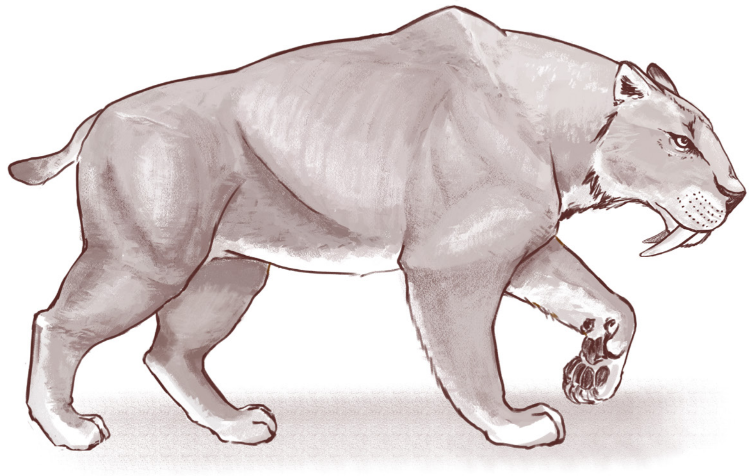
Sternberg, C. H. 1985. The Pleistocene Fossil Bed at McKittrick, California; pp. 214–221 in Hunting Dinosaurs in the Bad Lands of the Red Deer River, Alberta, Canada, third edition. NeWest Press, Edmonton, Alberta, Canada.

More technical articles describing and illustrating the bones from McKittrick

Brattstrom, B. H. 1953. Records of Pleistocene reptiles from California. Copeia 1953:174–179. https://www.jstor.org/stable/1439926

DeMay, I. S. 1941. Quaternary bird life of the McKittrick asphalt, California. Carnegie Institution of Washington, Publication 530:35–60.

Miller, L. 1924. Branta dickeyi from theMcKittrick Pleistocene. The Condor 26:178–180. https://www.jstor.org/stable/1363171



Miller, L. 1925. Avifauna of the McKittrick Pleistocene. University of California Publications, Bulletin of the Department of Geological Sciences 15:307–326.

Miller, L. 1927. The falcons of the McKittrick Pleistocene. The Condor 29:150–152. https://www.jstor.org/stable/1363081

Miller, L. 1935. A second avifauna from the McKittrick Pleistocene. The Condor 37:72–79. https://www.jstor.org/stable/1363879

Miller, L. 1942. A Pleistocene tortoise from the McKittrick Asphalt. Transactions of the San Diego Society of Natural History 9:439–442. https://www.biodiversitylibrary.org/page/5716249

Ross, 1935. A new genus and species of Pigmy Goose from the McKittrick Pleistocene. Transactions of the San Diego Society of Natural History8: 107—114. https://doi.org/10.5962/bhl.part.14896

Schultz, J. R. 1938. A late Quaternary mammal fauna from the tar seeps of McKittrick, California. Carnegie Institution of Washington Publication 487:111–215.

More technical articles about the age, environment, and geology of the seeps

Church, C. C. 1968. The McKittrick Tar Seeps; pp. 86–92 in Geology and Oil Fields, West Side Southern San Joaquin Valley. 43rd Annual Meeting, 1968, Guidebook (AAPG, SEG, SEPM Pacific Sections). American Association of Petroleum Geologists, Pacific Section

Fox-Dobbs, K. , R. G. Dundas , R B. Trayler, and P.A. Holroyd (2014) Paleoecological implications of new megafaunal 14C ages from the McKittrick tar seeps, California, Journal of Vertebrate Paleontology, 34:1, 220-223

Hodgson, S. F. 1987. Onshore Oil and Gas Seeps in California. California Department of Conservation, Division of Oil and Gas, Publication No. TR26, 97 pp.

Trayler, R. B., R. G. Dundas, K. Fox-Dobbs, and P.K. Van De Water. 2015. Inland California during the Pleistocene—Megafaunal stable isotope records reveal new paleoecological and paleoenvironmental insights. Palaeogeography, Palaeoclimatology, Palaeoecology 437:132-140.

About

The cataloging of this collection was made possible by a grant from the Institute of Museum and Library Services (MA-30-14-0244-14 to Charles R. Marshall).

Credits:

- Lisa White
- Patricia Holroyd
- Eric Holt
- Elyanah Posner
- Lauren Fowler
- Alexis Williams
- Helina Chin
- with Trish Roque, Joyce Gross, Diane Erwin, and Ashley Dineen

We thank the following for their work on the curation and imaging of the McKittrick fossil collection:

Kristy Cheng, Marwa Wafeeq El-Faramawi, Patrick Garcialuna, Danielle Kalani Heinz, Grant Howard, Armita Manafzadeh, Melissa Mast, Michele Marie Maybee, Spencer Murphy, Patrick Sysiong, Michael Tom, Sarah Tulga, Ali Young, and Zixiang Zhang