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WESTERN ASSOCIATION OF VERTEBRATE PALEONTOLOGY ANNUAL MEETING

Cover Image: *Titanotaria orangensis* (OCPC 721/11141) is a tuskless walrus, fondly known as "Waldo", from the Miocene of Orange County.

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WESTERN ASSOCIATION OF VERTEBRATE PALEONTOLOGY ANNUAL MEETING

ORANGE COUNTY PARKS

ARCHAEOLOGY AND PALEONTOLOGY DIVISION

COOPER LABORATORY, SANTA ANA, CA

and

SADDLEBACK COLLEGE

DEPARTMENT OF BIOLOGICAL SCIENCES

MISSION VIEJO, CA

MAY 27-28, 2023

Host Committee:

William Gelnaw, Meena Madan Richards, and Tony Huntley

OC Parks Archaeology and Paleontology Division & Saddleback College

PROGRAM & ABSTRACTS
MAY 27–28, 2023

Schedule of Events

Saturday May 27, 2023

8am – 1pm TALKS, POSTERS, & LUNCH at Saddleback College

1pm – 3:30pm JOHN D. COOPER LABORATORY TOUR

4pm – 6pm CLARK PARK INTERPRETIVE CENTER TOUR

Sunday May 28, 2023

8am – 12pm LIMESTONE CANYON GUIDED HIKE

ABSTRACTS

Alphabetically by first author

PRELIMINARY REPORT OF THE FOSSIL MARINE ORGANISMS IN A SAMPLE FROM EASTERN MISSION VIEJO

BAKHTIARI, Nikou; BASHOR, Tyler; BEGANDO, James; FOO, Chloe; GOODZARI, Masha; HARVEY, Li; NGUYEN, Ellen; PATINO, Alex; REED, Peregrine; and HUNTLEY, Tony, Department of Biological Sciences, Saddleback College, Mission Viejo, CA, USA; LOZANO, Hugo, Archaeological Resource Management Corporation, Rancho Palos Verdes, CA, USA

Between 1996 and 1998 the City of Mission Viejo and the Mission Viejo Company carried out grading and development activities immediately southeast of the intersection of Olympiad Road and Alicia Parkway in the City of Mission Viejo (known as Planning Areas 11 and 12). This resulted in the collection of many paleontological field jackets presumably from the upper and middle Miocene (Monterey and Capistrano formations). In 2005 a large number of these samples were transferred to Saddleback College, Mission Viejo for preparation and analysis. In this paper, we report on the results of the preparation of six jackets all from this area. These jackets yielded a fairly rich assemblage of marine organisms presumably living in the northern extension of the Capistrano Embayment present in the middle to late Miocene of that area (Fierstine, 2008). Most jackets consisted of easily removed, well sorted sandstone matrix. Fossils recovered included *Desmostylus* molars, dolphin vertebrae and ribs, sea lion vertebrae, an unknown fish skull, large fish vertebrae, a sting ray barb, numerous shark teeth, coprolites, and a whale vertebra. The matrix material is currently being washed for microscopic analysis.

Fierstine H (2008) A Fossil Skull of the Extant Blue Marlin (*Makaira nigricans* Lacepède, 1802) from the Late Miocene of Orange County, California. Bulletin of the Southern California Academy of Sciences 107 (2): 45–56.

LATE CRETACEOUS CHONDRICHTHYES FROM THE "FINAL FRONTIER" OF WYOMING, AND THEIR PALEOECOLOGICAL IMPLICATIONS

BERG, Emily, The Webb Schools, Claremont, CA, USA; BALISI, Mairin; FARKE, Andrew, Raymond M. Alf Museum of Paleontology, Claremont, CA, USA

Marine fossils from the Cenomanian to Turonian (Late Cretaceous) of the Western Interior Seaway of North America are well studied across many formations. Osteichthyans, chondrichthyans, crocodilians, dinosaurs, and sauropterygians are common finds. In contrast to the other Western Interior Seaway deposits, the faunal composition of the contemporaneous Frontier Formation, which occurs throughout Wyoming, is very poorly characterized. Compared to abundant shark taxa described from other formations of similar age in the Western Interior Seaway, only six Chondrichthyes species have been previously described from the Frontier: *Ptychodus* sp., the mackerel sharks *Scapanorhynchus* sp. and *Lamna* sp., and the batoids *Myledaphus* sp. and *Ptychotrygon* sp. The goal of this study is to inform paleoenvironmental background on the Frontier Formation in the western Big Horn Basin, and to develop a faunal list of recently discovered shark specimens for comparison to other localities from the Western Interior Seaway.

In 2021, the Raymond M. Alf Museum of Paleontology (RAM) first collected from the "Final Frontier'' locality (RAM V-2021016) in Park County, Wyoming. At this locality, the Frontier Formation includes bentonite, sandstone, siltstone, and chert conglomerate, along with abundant vertebrate bone and tooth clasts. The locality preserves teeth and vertebrae from species consistent with a nearshore, shallow marine environment, including fish, sharks, and crocodilians. In this study, I describe four shark teeth and identify three species of shark from this locality: the mackerel sharks *Archaeolamna kopingensis* and *Telodontaspis agassizensis,* and the hybodont shark *Meristodonoides* sp. While these sharks are typical of other formations from the Cenomanian, this study presents their first occurrences in the Frontier formation. Compared to at least five other North American localities from the Late Cretaceous, this current faunal composition aligns similarly to the Saskatchewan region in Canada, containing species that were likely endemic to the Western Interior Seaway. These results from a new locality reveal new insights into the paleoecology and paleoenvironment of the Western Interior Seaway during the Late Cretaceous period.

THE MAMMOTHS IN THE ARCTIC AND THE SILVER MOON

EL ADLI, Joseph, Department of Paleontology, Bargas Environmental Consulting, San Diego, CA, USA

The tusks of proboscideans (elephants and their relatives) contain a record of growth, which can be accessed through analyses of structural and compositional variations in recurring growth increments. These increments have been found to form on annual (first-order), weekly (second-order), and daily (third-order) intervals in woolly mammoths (*Mammuthus primigenius*). Under this regime, sets of lower-order increments are nested within increments of higher order. Among increments, the periodicities of the highest- and lowest-order increments are easily explained: circadian rhythm and seasonal change, respectively. However, the explanation for weekly second-order increments is less intuitive. These features have been hypothesized to form due to a "beat frequency" effect between the circadian

rhythm and some rhythmic aspect of tusk growth. Under this model, a shift in the periodicity of either of the two rhythms (e.g., change from an entrained to a free-running circadian rhythm) would change the "beat" of the second-order increments. MicroCT and photomicroscopic data from a partial woolly mammoth tusk from northern Chukotka, Russian Federation (above the Arctic Circle) with clear and continuous first-, second-, and third-order growth increments corroborates this hypothesis by showing a decrease in the overall number of second-order increments per first-order increment and a twice-per-annum increase in the number of third-order increments per second-order increment, which roughly correspond to the timing of the polar winter and summer. However, the temporal placement and duration of increment runs interpreted as forming during times of free-running circadian rhythm in the polar night appear to be later and shorter than expected in a simple model. This discrepancy is here interpreted as the result of entrainment of circadian rhythm from the rise and fall of the moon, which would still be visible during portions of the winter at Arctic latitudes.

THE CROSS DATING OF A PALEOGENE TYPOTHERIA TO DETERMINE THE AGE AND RANGE OF THE CACHAPOAL

ITIE, Dozie, Department of Paleontology, Bargas Environmental Consulting, San Diego, CA, USA

South America for most of the Cenozoic period was isolated, which led to a high degree of endemism. Because of the endemic fauna, the geology of South America is divided into biochronologic assemblages, called South American Land Mammal ages (SALMA). A recently established SALMA, the Tinguiririan, may possibly have a bigger geological range than currently believed. A river valley that approaches the Tinguiririan, the Cachapoal River Valley, has been hypothesized to be part of this SALMA and could extend its geological range. To answer this question, I describe a fossil notoungulate from the Cachapoal River Valley to determine whether it is Tinguiririan in age. Phylogenetic analysis places the fossil as a sister taxon to a clade containing *Protypotherium australe* and *Miocochilius*. The geological ranges of these sister taxa are younger than the Tinguiririan and indicate that the Cachapoal River Valley is not of the Tinguiririan age.

THE LA MIRADA LOCAL FAUNA: A RANCHOLABREAN ASSEMBLAGE FROM THE LA HABRA FORMATION IN THE EASTERN LOS ANGELES BASIN

LANGENWALTER, Paul, II, Biola University, La Mirada, CA, USA

A Rancholabrean fauna composed of invertebrate and vertebrate species has been recovered from a lacustrine deposit (LACM 8091) belonging to the La Habra Formation in the eastern Los Angeles Basin. The deposit outcrops in the La Mirada Creek drainage a short distance west of the point where the West Coyote Hills anticline dips beneath the surface of the east basin alluvial deposits. The deposit consists of sandy silt with sand lenses. Both contain granule to pebble-sized clasts including shale redeposited from the Puente Formation. The western and southern edges of the deposit were eroded by riverine action that cut through the lacustrine sediments leaving a channel with a course to medium sand fill. The silts at the erosional contact are defined by a dense accumulation of caliche in the form of nodules, root casts and coatings on some specimens. These deposits are overlain by a marshy stratum capped by alluvium. The locality was discovered during construction in 2002 on the campus of Biola University and sampled by students over the following 17 years. This resulting assemblage includes ostracods, six species of snails and mussel, three species of fish, a species of amphibian, several species of reptiles, three bird species, and 16 species of mammals. The lacustrine associated aquatic species include four aquatic snail species, freshwater mussel, rainbow trout, arroyo chub, prickly sculpin, pond turtle, toad, rainbow trout, and duck. Terrestrial species include a snail, several species of snake, quail, perching birds, hawk, cottontail, brush rabbit, jackrabbit, species of squirrel, mice, wood rat and gopher, bobcat, grey fox, dire wolf, Columbian mammoth, horse, a camelid, dwarf antelope and antelope. The terrestrial large mammal component is dominated by remains of *Mammuthus columbi* and *Capromeryx minor*. Given the species represented in the assemblage, the aquatic habitat was shallow and nearshore. The terrestrial habitats adjacent to the lake included brush (coastal sage scrub, chaparral) and open grassland. Some plant macrofossils imbedded in caliche are present, but pollen is nearly absent. The locality provides an important window into Rancholabrean paleoenvironment in the region. A Uranium-Thorium date of ~180,000 BP was obtained for the locality using a mammoth femur fragment for the locality. The marshy soil collected from the alluvium overlying the riverbed deposit yielded an organic sediment radiocarbon date of 21390 to 21120 cal BP (17730 +/- 70 BP).

DIETARY ECOMORPHOLOGY OF CANID PREDATORS FROM THE MCKITTRICK ASPHALT SEEPS, SOUTHERN CALIFORNIA

MASCHLER, Matt; HAN, Annie, The Webb Schools, Claremont, CA, USA; HOLROYD, Patricia, University of California, Berkeley, CA, USA; BALISI, Mairin, Raymond M. Alf Museum of Paleontology, Claremont, CA, USA

Because of their profound influence on modern ecological structure, the causes and consequences of the terminal Pleistocene carnivore extinction events continue to be a

focus of study. Specifically, dire wolves (*Aenocyon dirus,* formerly in *Canis*) went extinct during the end-Pleistocene, while other canids including grey wolves (*Canis lupus*) and coyotes (*Canis latrans*) have survived from the Pleistocene to present day. An oft-cited hypothesis for this differential canid survival is that dire wolves were more specialized predators than grey wolves and coyotes, and therefore dire wolves may have been more susceptible to extinction when their prey sources went extinct. Here, to test this hypothesis of ecological generalism versus specialization, we analyze the dietary ecomorphology of fossil canids from the Pleistocene-age McKittrick asphalt seeps on the southwest side of the Central Valley of California. We expect dire wolves to display traits for specialized, metabolically expensive feeding behavior like bone-cracking; while grey wolves and coyotes might instead have traits that maximize dietary variability, like retaining areas on the tooth row for slicing soft meat as well as chewing tough matter.

We examined 331 canid specimens (224 lower jaw and 107 upper jaw elements) from the McKittrick collection at the University of California Museum of Paleontology, Berkeley, for 31 linear measurements of the skull and teeth. Taphonomy at McKittrick appears to differ from the contemporaneous Rancho La Brea (RLB) asphalt seeps in Los Angeles: while RLB has excellent preservation, McKittrick fossils tend to be fragmentary and, despite the hundreds of specimens examined, our largest sample size was *n*=87 for the lower carnassial (lower first molar). The unmeasured sample also includes a good proportion of juveniles yet to be quantified. Bimodal distributions of our linear traits suggest only two species (dire wolf and coyote) at McKittrick with no overlap in traits, potentially another difference with RLB where grey wolves also occur. While these linear anatomical measurements correlate with size, they may not necessarily indicate ecological function; our next step therefore is to convert these traits into functional indices that approximate dietary ecology.

PLEISTOCENE MARINE VERTEBRATES FROM SANTA CRUZ ISLAND – AN UPDATE

POUST, Ashley W.; DEMÉRÉ, Thomas A., San Diego Natural History Museum, San Diego, CA, USA

Despite their recency, Pleistocene marine vertebrates are relatively rare. The paucity of Quaternary sublittoral and shelf deposits is a major contributing factor to this knowledge gap. In the case of the Eastern Pacific, this gap occurs during the transition from Pliocene faunas to marine assemblages dominated by extant groups. Fieldwork conducted since our previous WAVP talk in 2020 has expanded the collection of vertebrate fossils from the Middle Pleistocene of Santa Cruz Island (SCI) in the California Channel Islands, and this new material contributes to ongoing efforts to understand this important period.

The fossils represent a fauna from the T2 marine terrace on the western end of SCI. The T2 represents a Middle Pleistocene highstand, with recent dates from lower and higher terraces suggesting an early Chibanian age, possibly the Marine Isotopic Stage (MIS) 17c interglacial (~700 ka). The skeletal assemblage includes shark, ray, teleost, sea birds (representing *Phalacocorax*, *Ardea*, *Sula*, and *Chendytes*), postcranial elements from at least three otariid individuals, a lower canine (cf. *Mirounga*), a mysticete cervical vertebra (cf. *Eschrichtius*), and several bones and teeth of *Enhydra*, including a dentary with m1.

Even with the most conservative age estimates for T2, this material represents the oldest known adult dentition of *Enhydra*. The m1 has a large talonid, bicuspid metaconid, and large shelf labiodistal to the hypolophid. In these and other features the robust SCI otter differs from extant *E. lutris* and extinct *E. macrodonta*, and may represent hitherto unrecognized diversity within the sea otter lineage. The otariid bones resemble *Arctocephalus* more than members of Otariinae, particularly in vertebral anatomy and phalanx proportions. A large otariine atlas confirms it is a multitaxic otariid assemblage, unknown from the Eastern Pacific before the Middle Pleistocene. The presence in southern California of an otariid with arctocephaline affinities suggests that the arrival of new otariid groups to the Eastern North Pacific may have been quickly established following the loss of odobenid diversity around the Plio-Pleistocene boundary and provides potential data for understanding arctocephaline dispersal from the Southern Hemisphere.

More broadly, the mixture of extant mammalian genera and extinct avifauna may point to differential timing of turn-over between the two groups. Additional recovery and description of Pleistocene marine vertebrates will help to establish the speed and geographic pattern with which the dramatic Pliocene to Quaternary faunal turnover became established in the Eastern Pacific.

***BISON ANTIQUUS* FROM REDWOOD CITY, CALIFORNIA: EXPANDING THE PLEISTOCENE RANGE IN THE SAN FRANCISCO PENINSULA**

SCHERZER, Benjamin, Chronicle Heritage, Redlands, CA, USA

While providing paleontological monitoring for commercial building construction in Redwood City (San Mateo County, California) in 2020, a partial bovid skull was recovered from sediments at the border between alluvial and bay deposits. This specimen was identified as *Bison antiquus* from the Late Pleistocene. Redwood City represents a previously fossil-poor region of the San Francisco Peninsula, and the presence of a *Bison* specimen expands the known range of Pleistocene fauna in the area.

THE ECOMORPHOLOGICAL EVOLUTION OF THE BOBCAT OF SOUTHERN CALIFORNIA

SUH, Dayun, The Webb Schools, Claremont, CA, USA; BINDER, Wendy, Loyola Marymount University, Los Angeles, CA, USA; BALISI, Mairin, Raymond M. Alf Museum of Paleontology, Claremont, CA, USA

Mesocarnivores—small mammalian carnivores—are relatively understudied given their prevalence in today's ecosystems. One such mesocarnivore is the bobcat (*Lynx rufus*), a medium-sized felid that resides in canyons as well as large cities. In Southern California, bobcat fossils have been found in the Pleistocene to Holocene-age Rancho La Brea (RLB) asphalt seeps in Los Angeles (L.A.) and are still extant.

We hypothesize that large-scale ecological and environmental changes at the end of the last Ice Age have produced morphological differences between fossil and modern bobcats. Our as-yet unpublished radiocarbon dates show that RLB bobcats tend to pre-date the Last Glacial Maximum; therefore, our comparison spans a difference of 30 to 40 ka. Here, we compare RLB bobcats at the La Brea Tar Pits & Museum with historic L.A.-area bobcats at the Natural History Museum of L.A. County. Using caliper measurements, we find that fossil bobcats tend to have larger teeth and longer limbs than modern bobcats, showing a body-size decrease from pre-glacial to modern-day. Combining these linear measurements into functional indices, we find minimal change in jaw function but possible shifts in locomotor behavior, particularly in the hindlimb. To further interpret the locomotor shifts, currently we are conducting three-dimensional geometric morphometrics, a method of quantifying and comparing the shape of 3D objects, using a MicroScribe digitizer.

The body-size decrease may stem from the end-Pleistocene extinction of megafauna, including predators like saber-tooth cats that may have suppressed bobcats directly or indirectly ("top-down"). Alternatively, climate and vegetation shifts also at the Pleistocene-Holocene boundary may have affected the bobcat's small-mammal prey, ultimately impacting the bobcat ("bottom-up"). Morphological change also may have occurred through phenomena like Bergmann's Rule: cold climates during the Last Glacial Maximum ca. 20,000 years ago may correlate with large body size. While the morphological differences might be interpreted as resulting from the loss of large predators and the subsiding of their prey, complementary stable isotope results suggest that the bobcat's morphological changes rather were likely in response to the environmental transition at the end of the last Ice Age.

ON THE ABILITY TO INFER CLAW FUNCTION FROM MORPHOLOGY IN EXTINCT VERTEBRATES: YES WE CAN!

THOMSON, Tracy J., University of California – Davis, Davis, CA, USA

Claws are important for understanding animal ecology because they function at direct points of contact between the animal and its environment. But the link between claw form and function has been historically difficult to quantify, analyze and interpret, particularly for extinct animals. A more detailed understanding of the morphological relationships between claw sheaths and unguals and a methodology that would allow claw function to be inferred from morphology with a higher degree of accuracy would help paleontologists infer and interpret the ecology of fossil vertebrates more clearly.

I have investigated relationships between claw form and function through detailed inspection of 80 modern bird and mammal claw specimens. These were assigned to one of eight new, functionally based categories after an extensive review of direct observations recorded in the literature. Twenty morphological metrics of the whole claw (9 from the sheath, 11 from the ungual) were measured and analyzed using principal component (PCA) and linear discriminant (LDA) analyses incorporating a supervised dimensionality reduction method called J-function. PCA shows that the sheath is morphologically more disparate than the ungual. However, a small portion of the morphospace covered by the ungual is not overlapped by the sheath, indicating that the ungual contains morphological information not captured by the sheath. Sheath measurements do a slightly better job at correctly predicting claw function than ungual measurements in LDA. However, using both structures decreases the misclassification rate by more than half, allowing claw function to be correctly predicted from morphology with a success rate around 95%.

I applied this approach to ten claws (6 pes, 4 manus) from three *Archaeopteryx* specimens. Whether this genus was primarily arboreal or terrestrial has been a controversial subject. None of the claws overlap in morphospace with claws used by modern animals for running; they overlap with claws used for grasping, climbing, and generalist functions. LDA classifies the claws as either climbing, generalist, or grasping. The claw morphology of *Archaeopteryx* thus suggests that climbing and grasping were important aspects of its lifestyle and ecology. Together with results from previous functional morphology studies, these results support the hypothesis that *Archaeopteryx* adapted and specialized different parts of its body for different functions. This mosaic evolution would be expected in a "transitional form" such as *Archaeopteryx*.

This methodological framework can and has been applied to other fossil organisms as well, opening a new way to better understand claw function in paleoecologic and evolutionary contexts. Already these methods have been successfully used by other researchers to infer claw function in other fossil organisms such as the Late Carboniferous eureptile *Anthracodromeus* (Mann et al., 2021) and the Late Triassic archosauromorph *Sphodrosaurus* (Ezcurra & Sues, 2021). Future studies are either planned or in the works for groups such as dromaeosaurid dinosaurs and pterosaurs.

DESCRIPTION OF FIRST RECORDED *EQUUS OCCIDENTALIS* AND ASSOCIATED TAXA FROM SAN JUAN CAPISTRANO, ORANGE COUNTY, CALIFORNIA

YARD, Maree M., Department of Geosciences, Baylor University, Waco, TX, USA; SCOTT, Eric, California State University San Bernardino, San Bernardino, CA, USA

Pleistocene non-marine deposits in Southern California's Orange County region are abundantly fossiliferous, and development projects over many decades have yielded a rich trove of specimens. However, many fossils of terrestrial vertebrates from the area remain poorly reported or described. To help address this lack, we examined Pleistocene equid remains from San Juan Capistrano, California, and determined that these remains are sufficiently diagnostic both morphologically and metrically to warrant assignment to the species *Equus occidentalis*. This is the first confirmed record of this species from anywhere in Orange County.

From Pleistocene deposits in Southern California, two morphospecies of large stout-limbed horses have previously been reliably documented: *Equus scotti* from early- middle Pleistocene deposits, and *Equus occidentalis* from latest Pleistocene sites. These species are readily distinguished dentally; *E. scotti* possesses lower incisor infundibula, while *E. occidentalis* lacks them. However, fully diagnostic remains of *E. scotti* and/or *E. occidentalis* are previously known from very few localities regionally, and most prior identifications have been based upon isolated teeth or other insufficiently diagnostic fossils. It is therefore necessary to examine more complete remains to determine whether the proposed temporal pattern is real, or instead is an artifact of the lack of diagnostic material.

Specimens employed for this study, and housed at the John D. Cooper Laboratory and the Mission Viejo Library, included a skull, mandible, articulated right hind leg, and other post-crania interpreted to represent a single individual of a young adult female horse. These remains were recovered in close association from non-marine terrace deposits exposed as part of a construction project. Metric data from post-cranial elements confirm that this is a large species of horse. Morphologically, the metapodials are stout rather than slender, while the lower incisors lack infundibula. In combination, these characters demonstrate affinity with *Equus occidentalis* rather than *E. scotti.*

Fossils associated with the horse possibly include mammoth (likely *Mammuthus columbi*), leporid, and bird; these specimens remain to be more fully described. Field reports from the site indicated the presence of *Bison*, an index taxon for the late Pleistocene, but this assignment remains unconfirmed due to the fragmentary nature of the remains.