dental features of *Russellagus* and *Hesperolagomys*, and identify dental characters that are stable during ontogeny of *Russellagus* and *Hesperolagomys*. Characters that do not change significantly during ontogeny and are useful for systematic study include: length of occlusal surface, morphology and molarization of P3, persistence of lingual hypostria and crescentic valley, extent of lingual hypostria and crescentic valley expressed at the occlusal surface, degree of hypsodonty, and dental complexity.

UNSCRAMBLING THE EGG: DIGITAL EXTRACTION OF AN ELEPHANT BIRD (*AEPYORNIS*) EMBRYO FROM AN INTACT EGG

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Geoffroy St.-Hilaire first described the extinct elephant bird, *Aepyornis*, from the Holocene of Madagascar in 1851. Numerous subsequent studies focus solely on the adult anatomy; whereas, the embryonic skeleton of *Aepyornis* is largely unknown. Scanning an intact *Aepyornis* egg at the University of Texas at Austin High Resolution X-ray Computed Tomography (CT) Facility revealed the presence of a disarticulated embryo. These scans, coupled with new image processing techniques, provide a nondestructive method to digitally prepare the embryo for study. Individual bones are digitally isolated and then "printed" on a three-dimensional rapid prototyping device. This procedure is a unique way to view the embryonic skeleton without damaging the specimen.

Although disarticulated, a large percentage of the skeleton remains relatively undamaged. Many cranial and postcranial elements are now represented by three-dimensional printouts; including frontals, parietals, quadrates, maxillae, the premaxilla, the supraoccipital, a squamosal, a palatine, an articular, a tibiotarsus, several vertebrae, a femur, a fibula, a tarsometatarsus, and part of the synsacrum. The ability to isolate, analyze, and describe what before would be an inaccessible specimen provides unique data that can now be applied to any type of future study (i.e. phylogenetic, ontogenetic, functional morphology).

A MORPHOMETRIC CONTRIBUTION TO RHINOCEROS PHYLOGENY: CANONICAL VARIATE STUDIES OF EXTANT AND FOSSIL SKULLS (RHINOCEROTOIDEA: PERISSODACYTLA)

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The five-species, four-genus view of living rhinos has been stable, but the relationships among genera have been variably interpreted. The problem includes a confounding of biogeography and horn number by *Dicerorhinus*. It is geographically Asian but has two horns. *Rhinoceros*, also Asian, is one-horned, while the African genera (*Diceros; Ceratotherium*) are two-horned. Among proposed hypotheses are these three: (1) horn number primary, geography secondary (*Dicerorhinus* belongs in an African group), (2) geography primary, horn number secondary (*Dicerorhinus* belongs in an Asian group), (3) geography and horns both primary (*Dicerorhinus* is basal). A recent molecular study supports the first hypothesis.

This study investigates shape relationships among extant and fossil genera in a canonical variates (CV) morphospace using skull measurements. Previous principal components (PC) analyses showed that the degrees of intrageneric, interspecific, and intraspecific variation for crania and mandibles have been similar across time and taxa, giving a good estimate of within-group variation. CV morphospace ordinates the genera along axes of maximum separation, having accounted for within-groups variation.

PC studies also showed that the measurements detected shape differences to the geographic and interquarry level within species. If the "core" rhino skull shape is conservative (as it seems), then skull shape may contain some extractable phylogenetic information, since closely related taxa "stick" close to each other morphologically (shared derived shape).

Preliminary CV's have shown a mixture of results for shape associations of *Dicerorhinus*. All the plots separate *Rhinoceros* from *Ceratotherium* and *Diceros*, but show *Dicerorhinus* as basal (similar to *Aphelops*) or similar to *Diceros* (in an isometric size-free approach). Mandile plots place *Dicerorhinus* closest to *Diceros*, but with a unique shape (not basal).

REDESCRIPTION AND REVISED TAXONOMIC STATUS OF *PALAEOSANIWA CANADENSIS* BASED UPON NEW MORE COMPLETE MATERIAL

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Since its discovery and initial description in 1928, *Palaeosaniwa canadensis* has been a problematic anguimorph lizard taxon. Though the original description is based upon a single vertebra, subsequently referred material has largely been other fragments of vertebrae, sometimes with associated teeth and jaw fragments, and less often with some very fragmentary limb material. These scrappy remains were recovered from both Campanian and Maastrichtian strata. Recent discovery of a new, significantly more complete specimen, recovered by parties from the Museum of the Rockies, from the Judith River Formation of Montana, (making it close in age to the holotype), reveals a partially articulated fossil that includes significant cranial and post-cranial material, and it exemplifies all of the vertebral morphology that Gilmore used to erect this taxon. This MOR specimen, as well as additional undescribed material from the University of California Museum of Paleontology, allows for a new redescription of this equivocal taxon and enables a better understanding of its phylogenetic position within the Anguimorpha and Varanoidea. Current PAUP* 4.0 analyses indicate that *Palaeosaniwa* shows greater affinities to monstersaurian varanoids than to any members of the Varanidae, the taxon within which *Palaeosaniwa* has currently been assigned.

A PRIMITIVE ALBIREONID DOLPHIN (CETACEA, ODONTOCETI, DELPHINOIDEA) FROM HOKKAIDO, JAPAN

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The extinct North Pacific delphinoid odontocete family Albireonidae was originally based only on latest Miocene (circa 8 to 9 Ma) *Albireo whistleri* from Baja California, Mexico. Its derived characters include: large brain case, elevated cranial vertex, dorsally curved rostral extremity, large premaxillary eminences, flat nasal bones, anteroposteriorly compressed vertebrae, very slender and elongate neural and transverse processes of the dorsal vertebrae, and very wide and flat pectoral flipper bones. Its primitive characters include: symmetrical cranial vertex, basicranium lacking extensive air sinuses, and unfused cervical vertebrae. The family Albireonidae has not been universally accepted as valid; one suggestion being that *A. whistleri* is a porpoise (family Phocoenidae). However, other latest Miocene and Pliocene species in this family have subsequently been discovered in California. We have discovered a new, very primitive, Late Miocene species of Albireonidae near Sapporo, Hokkaido, Japan. This northern-most occurrence of the Albireonidae, the first discovery of the family from the western North Pacific, demonstrates that the Albireonidae existed for at least 10 Ma. This new species is more primitive than *A. whistleri* by having a smaller brain case, larger cranial crests and tuberosities, and fewer teeth. In contrast to *Albireo*, its cranial vertex is skewed asymmetrically to the left side, a phenomenon correlated with anatomical modifications permitting production of highly sophisticated sounds for echolocation. Asymmetry in this earliest known albireonid suggests that this is a shared primitive character among basal members of the delphinoid families Monodontidae, Delphinidae, Albireonidae, and Phocoenidae. If this is true, the symmetrical cranial vertices of later *A. whistleri* and the Recent species of Phocoenidae evolved convergently via reversal to the primitive state as exists in the basal delphinoid family Kentriodontidae.

ASSESSMENT OF MAMMALIAN SPECIES RICHNESS IN THE NORTHERN GREAT PLAINS, NORTHERN ROCKY MOUNTAINS, AND PACIFIC NORTHWEST DURING THE EARLY ARIKAREEAN

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Patterns of species richness in space and time reflect (a) the underlying ecological processes that assembled a particular group of species and (b) the sampling procedure and analytical methods used to calculate diversity. Separating what aspects of diversity patterns arise from biological processes (signal) versus methodology (noise) in paleontological deposits is especially vexing, because taphonomic pathways and collecting techniques seldom are identical from site to site. Yet interpreting species diversity from fossil data sets is essential to understanding what is "natural" for biodiversity patterns today. To more reliably determine how to extract biological signal from methodological noise in fossil data, we used the MIOMAP database to analyze mammalian species richness through the early Arikareean (Miocene) in three biogeographic regions (northern Great Plains, northern Rocky Mountains, and Pacific Northwest). We employed several techniques, including uncorrected counts of species, standardizing for time averaging in various ways, rarefaction, bootstrapping, and using a "Rosetta stone" approach that compares only sites with similar sample sizes and taphonomic history. The results demonstrate that different interpretations of species richness patterns result from different ways of treating the data. This underscores the need for simultaneously applying the regional database and rosetta stone approaches to obtain the most reliable conclusions about species diversity in the fossil record.

DIFFERENTIAL AND DETERMINATE GROWTH IN DINOSAURS AND OTHER REPTILES

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Rapid, determinate long bone growth evolved independently in birds and mammals and is achieved by distinctive cellular kinetics. Bone elongation results through the replacement of growth plate cartilage by newly forming metaphyseal bone. Growth plate cells undergo a life history in which they longitudinally extend the ends of long bones and then relinquish their space, thus serving as a scaffold into which bone cells transgress. The primitive reptilian condition has been modified in both lineages to enable rapid, determinate growth. In both birds and mammals, upon reaching adult stature, the growth plate closes and bone elongation is no longer possible. To bring about rapid bone elongation, mammals rely primarily on directed cellular swelling (hypertrophy), analogous to cellular mechanisms affecting longitudinal growth of plant stems. The mammalian growth plate retains the primitive architecture in

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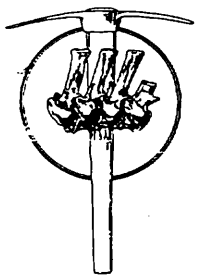

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