

Richard F Kay, Professor & Chairman, Biological Anthropology & Anatomy and Internal Scientific Advisory Committee

Contact Info:

Biological Sciences Building
919-684-2143
richard.kay@duke.edu

Education:

- Ph.D., Yale University, 1973
- M. Philosophy, Yale University, 1971
- B.S., University of Michigan, 1969

Research Interests: *Evolution of primate adaptations, anthropoid adaptations and phylogenetics*

Current projects: Paleontological research in Argentina (NSF funded), Paleontological research in India (LSB Leakey funded to Blythe Williams)

I have several areas of research. The first encompasses the evolution of primates and mammalian faunal evolution, especially in South America. I also have written extensively on the subject of the evolutionary origins of the Anthropoidea (monkeys and apes). More generally, I am interested in the use of primate anatomy to reconstruct the phylogenetic history and adaptations of living and extinct primates, especially Anthropoidea.

Click [here](#) to visit my Web site on paleontological research in the Rio Gallegos area of Argentina.

Evolution of Primates and of Mammalian Faunas in South America

For the past several years, I have been engaged in research in Argentina, Colombia, and Bolivia with three objectives:

1. to reconstruct the evolutionary history and adaptive patterns of South American primates and other mammals;
2. to establish a more precise geologic chronology for the mammalian faunas between the late Eocene and middle Miocene (between about 36 and about 15 million years ago); and
3. to use anatomy and niche structure of modern mammals as a means to reconstruct the evolution of mammalian niche structure in the Neotropics.

Primate Anatomy -- Implications for Phylogeny and Adaptations

A major theme of my work is to improve our understanding of two related topics:

1. the phylogeny of primates based (principally) on anatomical evidence; and
2. inferring the adaptations of extinct primates based mainly on cranial and dental evidence.

Plans for Future Research

Plans for research over the next 3-5 years are embodied in three projects. One is a particularly important site called the Gran Barranca in Patagonian Argentina that spans the Eocene-Oligocene transition, a period of particularly significant climatic change. A second project concentrates more particularly on recovery of early SA primate fossils at several localities of middle Miocene age (~16 Million years ago) in Argentine Patagonia. Finally, a project with Blythe Williams (principal investigator) is beginning in western India to search for continental vertebrates (especially primates) from the Paleocene through the Miocene.

Tracing Climate Change in the Eocene-Oligocene interval

This research is a study terrestrial biotic change in Patagonia through the Eocene-Oligocene transition (EOT). The end of the Eocene and the beginning of the Oligocene mark an important change in world climate from latitudinally more uniform, warmer, and more equable conditions to climates characterized by more latitudinal variation, cooler temperatures and more seasonality, i.e., when world climate transitioned from 'greenhouse' to 'icehouse'. The causes of this change are complex but involved regional tectonic activity as well as reorganized oceanic circulation. The timing and biotic impact of the change has been studied in the continental records of North America, Europe and Asia and shows a response to both local and global influences. As yet, however, no sequence of continental mammals and plants for the Eocene-Oligocene transition has been studied in the Southern Hemisphere. Recent revision of the ages of rock units and biotas in Patagonia has demonstrated that the Sarmiento Fm at Gran Barranca at 45° South in Patagonian Argentina spans the late Eocene through early Oligocene interval. In fact, this is the only known continental vertebrate and plant sequence so far identified from the Southern Hemisphere that spans this interval. The formation contains an as-yet inadequately sampled, but certainly rich, sequence of mammalian faunas and plant microfossils. Preliminary analysis of the mammalian herbivores suggests that dramatic changes occurred over a comparatively short interval of geologic time. The same sedimentary interval contains plant microfossils that document important change in the plant communities. Pilot data from mammalian tooth enamel suggest that these events occurred within the context of increasingly arid and more seasonal environments. The precise timing and nature of this biotic change, and its relation to the marine and Northern Hemisphere changes, will remain obscure until more fossils are collected in a more highly resolved temporal framework.

In this collaborative research undertaking, the geochronology of the Sarmiento Fm at Gran Barranca will be further refined using radiometric dating, chemical identification of tephra, and paleomagnetism. Stratigraphically-controlled collections will be made of vertebrates and plant microfossils. Climate change and its impact on the biota will be assessed 1) using biogeochemical analysis of stable oxygen isotopes in fossil mammalian tooth enamel; 2) by documenting changes in mammalian community structure (richness, origination and extinction rates, and ecological morphology); and 3) by documenting changes in vegetation and floral composition from the study of phytoliths. These three independent lines of evidence in a refined geochronologic framework will then be compared with similar evidence from continental sequences in the Northern Hemisphere and oceanic climatic data to improve our understanding of the timing and character of climatic change in continental high latitudes during this temporal interval.

Paleontological Investigations to Recover Fossil Monkeys from the Middle Cenozoic of South America

The pattern of monkey evolution in South America is poorly documented and little understood. Some argue that New World monkeys (Platyrrhini) known from 16-20 million year old rocks of Patagonia predate the origins of the modern families, that is, they are 'stem platyrrhines'. Others argue that they are early representatives of the modern platyrrhine families. The two alternative interpretations have profound implications for how the evolutionary radiation of platyrrhines is viewed. Further fossil material of early platyrrhines will contribute to resolving this debate. A joint team of US and Argentine paleontologists will search for fossil primates in ~16 million-year-old rocks of the Santa Cruz Formation and its equivalents in Patagonian Argentina. Collecting will concentrate on proven localities and expand collecting efforts to other lesser-known sites said to be richly fossiliferous from the Atlantic coast inland to the Andean front at 50-55 degrees South latitude. Analysis of the existing materials and recovery of even more complete specimens of primates will offer a rare insight about the phylogeny and adaptations of these early anthropoid primates. A phylogenetic analysis will clarify the pattern of diversification of South American platyrrhine monkeys and help to refine hypotheses about the origins of the modern platyrrhines families. To reconstruct adaptive profile of the various extinct species, a team of scientists from the US, Argentina and Brazil will study various aspects of the teeth, skulls and limb bones to reconstruct important details of the each species' adaptation and life history. Collections of other faunal remains by the field group will fill out the environmental context in which early platyrrhines evolved. A second team of research specialists headed by the Argentine scientists will study the functional anatomy and ecomorphology of non-primate fossils. Much work already has been undertaken to study the sloths and armadillos. Using these established approaches as a model, the research group will extend this work to encompass other major mammal groups including rodents, notoungulates, and marsupials.

Exploration for middle Cenozoic primates, Kutch District, Gujarat, western India

This funded project led by Blythe Williams and in collaboration with scientists at Panjab University will undertake a reconnaissance of Cenozoic (especially late Oligocene and

early Miocene) rocks of Kutch, Gujarat State. The scientific importance of such an undertaking is high for documenting the earlier (hominoid) stage of human evolution. The immediate ancestors of the living Asian monkeys and apes, macaques, gibbons, and orangutans had African origins and dispersed to Europe and the Middle East beginning about 18 million years ago. But the oldest hominoid remains in Indo-Pakistan are dated at about 12 Ma. The timing of the movement of hominoids into Indo-Pakistan, and the nature of the evolutionary radiation of early representatives of the modern groups is constrained by the extremely poor record of fossil mammal sites older than 12 million years in this region. Since there are records of these groups from Turkey going back to 16 million years it is reasonable to suppose that they could have reached India in the early Miocene. We propose to prospect early Miocene strata already known to be fossiliferous in hopes of recovering early Miocene fossil apes.

Representative Publications [\(More Publications\)](#)

1. Kay, R.F., Fleagle, J.G., Mitchell, T.R.T., Colbert, M.W., Bown, T.M., Powers, D.W., "The anatomy of *Dolichocebus gaimanensis*, a primitive platyrrhine monkey from Argentina." 2008: 323-382.
2. Kay R.F., Simons E.L., Ross J.. "The basicranial anatomy of African Eocene/Oligocene anthropoids. Are there any clues for platyrrhine origins?." *Elwyn Simons: A Search for Origins*. Ed. Fleagle J.G., Gilbert, C. C.. Springer, 2008
3. Perry J.M.G., Kay R.F., Colbert M.W.. "Tooth root size and chewing muscle leverage in *Homunculus*, a Miocene Primate from Patagonia." 2007: 110A.
4. Ross, C.F. and R.F. Kay. *Anthropoid Origins: New Visions (Advances in Primatology)*. Kluwer/Plenum, 2004. 747 pp.
5. R.F. Kay. Review of The Primate Fossil Record. ed. W. Hartwig. *American Journal of Human Biology* 15.6 (2003): 839-840.
6. Fleagle, J.G., R.F. Kay, and M.R.L. Anthony. "Fossil New World monkeys." *Vertebrate Paleontology in the Neotropics* (1997): 473-495.
7. R.F. Kay, Vizcaino, S. F., Bargo M.S., Perry J.M.G., Prevosti F., Fernicola J.C.. "Two new fossil vertebrate localities in the Santa Cruz Formation (late early Miocene, Argentina), ~51 degrees South latitude." 2008: 187-195.
8. Teaford, M. , Ungar, P., Kay, R.F.. "Molar shape and molar microwear in the Koobi Fora monkeys: ecomorphological implications." *Koobi Fora Research Project, Volume VI, Monkeys*. Ed. Jablonski, N., M.G. Leakey. California Academy of Sciences: San Francisco, 2008
9. Vizcaino S.F., Bargo M.S., Kay R.F.. "Reconstructing the paleoecology of the Santacrucian fauna (Early-Middle Miocene; Patagonia; Argentina) From form and function. Armadillo and primate examples.." 2006: 135A.
10. Plavcan, J.M., R.F. Kay, W.L. Jungers, and C. van Schaik. *Reconstructing Behavior in the Primate Fossil Record*. Advances in Primatology. New York: Kulwer/Plenum Publishers, 2001. 350 pp.
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14. Fleagle, J. G., R.F. Kay. "A new humerus of Homunculus from the Santa Cruz Formation, (early-middle Miocene, Patagonia)..". 2006: 62A.
15. Ross, C.F. and R.F. Kay. "Evolving perspectives on Anthroipoidea." *Anthropoid Origins: New Visions*. Ed. C.F. Ross and R.F. Kay. Kulwer/Plenum: New York, 2004. 3-41.
16. Kay, R.F., R.H. Madden, R.L. Cifelli, and J.J. Flynn. *Vertebrate Paleontology in the Neotropics*. Washington, D.C.: Smithsonian Institution Press, 1997. 592 pp.
17. Tafforeau, P. Boistel, R. Boller, E. Bravin, A. Brunet ,M. Chaimanee, Y. Cloetens, P. Feist, M. Horszowska J. Jaeger, J.-J. Kay, R. F. Lazzari, V. Marivaux, L. Nel, A. Nemoz, C. Thibault, X. Vignaud, P. Zabler, S.. "Applications of X-ray Synchrotron microtomography for non-destructive 3D studies of paleontological specimens.." 2006: 195-202.
18. Kay R.F., Kirk E.C., Malinzak M., Colbert M.W.. "Brain size, activity pattern, and visual acuity in Homunculus patagonicus, an early miocene stem platyrrhine: the mosaic evolution of brain size and visual acuity in Anthroipoidea.." 2006: 83A-84A.
19. Ross, C.F. and R. Kay, F. "Anthropoid Origins: Retrospective and Prospective." *Anthropoid Origins: New Visions*. Ed. C.F. Ross and R.F. Kay. Kluwer/Plenum Publishing: New York, 2004. 699-737.
20. R.F. Kay. "A new pitheciin primate from the middle Miocene of Argentina." *Am. J. Primatol.* 45 (1998): 317-336.
21. Vizcaino, S.F., Bargo, M.S., Kay, R.F.,Milne. "The armadillos (Mammalia, Xenarthra, Dasypodidae) of the Santa Cruz formation (early-middle Miocene)." 2006: 255-269.
22. Kirk, E.C. and R.F. Kay. "The Evolution of High Visual Acuity in the Anthroipoidea." *Anthropoid Origins: New Visions*. Ed. C.F. Ross and R.F. Kay. Kluwer/Plenum Publishing: New York, 2004. 539-602.
23. Kay, R.F., B.A. Williams, and F. Anaya. "The adaptations of Branisella boliviana, the earliest South American Monkey." *Reconstructing Behavior in the Primate Fossil Record*. Ed. Plavcan, J. M. Kay, R. F. Jungers, W. L. van Schaik, C.. Kulwer/Plenum Publishers: New York, 2002
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26. Kay, R.F. and R.H. Madden. "Mammals and rainfall: paleoecology of the middle Miocene at La Venta (Colombia, South America)." *J. Hum. Evol.* 32 (1997): 161-199.
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